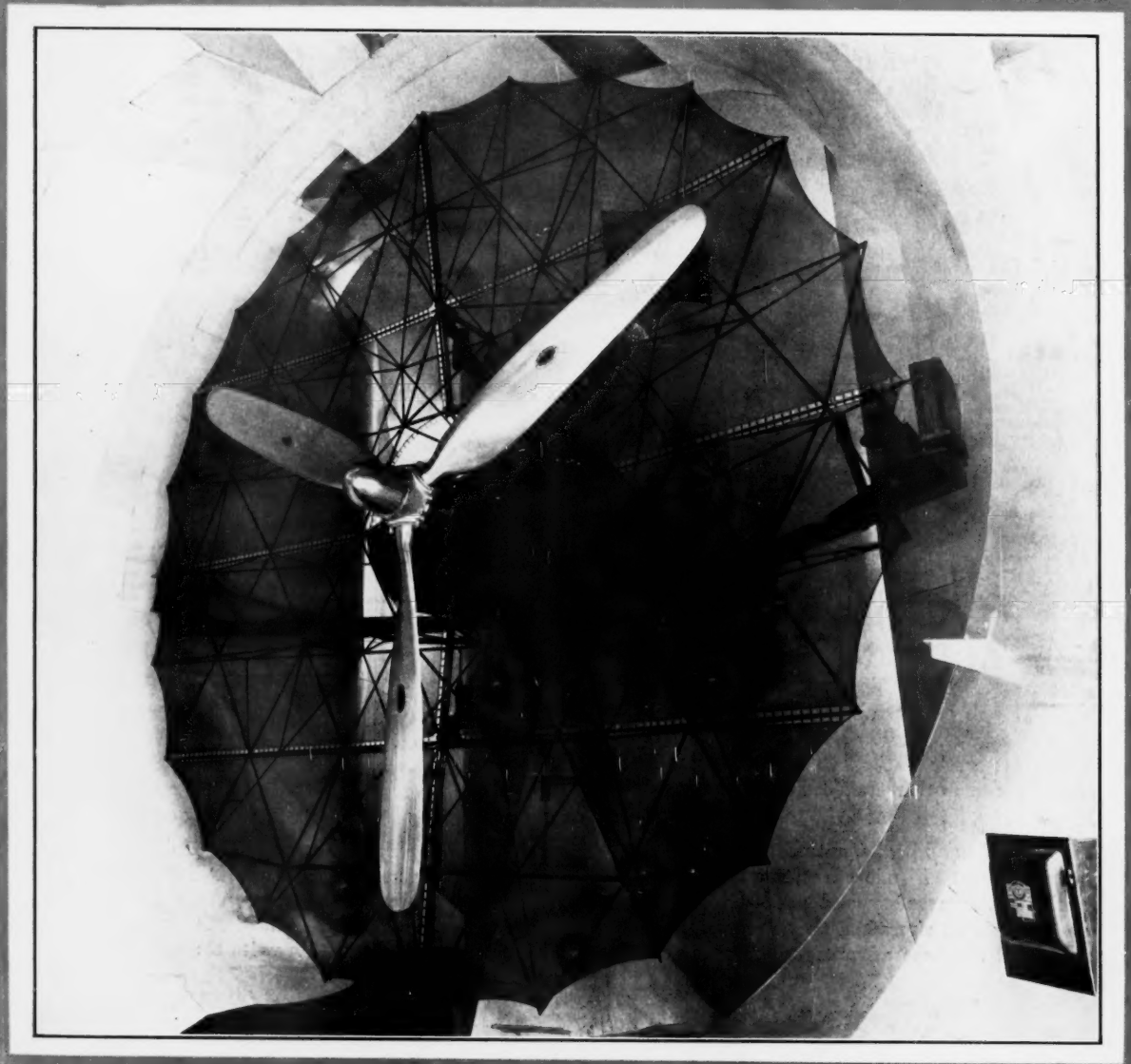
AERONAUTICAL ENGINEERING REVIEW

JANUARY 1946



STROMBERG

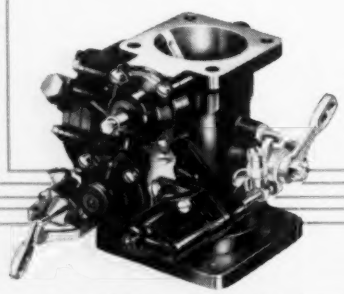
The Greatest Name in Aircraft Carburetion

Introduces

Injection Carburetion

for the

Light Plane Field!



In presenting this new P S Series Stromberg Carburetors, the advantages of Stromberg* Injection Carburetion, which equipped practically all military airplanes during the war, are made available for the first time to the private flyer and other users of light aircraft.

Non-icing characteristics; freedom from gravity effect in dives, climbs and banks, automatic compensation for temperature and altitude effect; predictable fuel consumption—all are safety and performance factors as important to light aircraft as they were on military airplanes—and all these advantages are incorporated in the new light plane Stromberg Injection Carburetors.

Available in various sizes for engines of 50 to 500 horsepower, this new Series of Injection Type Carburetors has been exhaustively tested in actual flight on small planes under severe atmospheric conditions and in the laboratory with the latest scientific testing equipment.

Measured by exacting standards of design, workmanship and performance, this new P S Series of Injection Carburetors are the most advanced product of STROMBERG—the Greatest Name in Aircraft Carburetion. For complete information write to:

*REG. U. S. PAT. OFF.

Bendix **PRODUCTS DIVISION**

Bendix Aviation Corporation, South Bend 20, Ind.

Bendix AVIATION CORPORATION

THE greatest all-purpose snow and ice tire built for aircraft is the Goodyear Ice-Grip tire. So pilots report after thousands of war and postwar flights under Arctic conditions.

There's better control on ice, or on snow-packed runways when your plane is equipped with Ice-Grips. Thousands of strong claws bite into the ice as the Ice-Grip tire makes its landing — for embedded in the rubber tread are thousands of tiny, high-tensile steel springs (10,000 in a large-size tire). There's no lumpiness, no bumpiness; the tires roll smoothly on concrete or other pavement, because the coil springs are solidly molded into the rubber. They won't tear out and bullet through your wings or fuselage.

Further, Ice-Grip tires give added traction on slippery turf runways. These multiple advantages make Goodyear Ice-Grips the safest choice for airliners whose flights cover several climate zones. Ice-Grips are an outstanding type in the great Goodyear line of airplane tires.

FOR ADDITIONAL ASSURANCE, insist on Goodyear Multiple or Single Disc Brakes. Write Goodyear, Aviation Products Division, Akron 16, Ohio, or Los Angeles 54, Calif.

Manufacturers, Airline Operators, Distributors, Dealers, and Private Flyers
DEPEND ON GOODYEAR for —

TIRES • TUBES • WHEELS • BRAKES • AIRCRAFT HOSE • HYDRAULIC HOSE • HYDRAULIC PACKING • GASKETS • GRIPTRED • LIFE RAFTS • DUCTS • CHEMIGUM SHEETS • FUEL AND OIL CELLS • RUBBERIZED FABRIC • ENGINE MOUNTS • AIRFOAM CUSHIONING • PLIOFILM • PLIOFORM • PLIOFOAM • HYDRAULIC PRESS PADS • MOLDED RUBBER PRODUCTS • ICEGUARD PROPELLER BOOTS

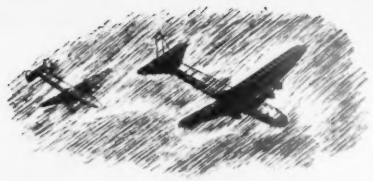
THE GREATEST NAME IN RUBBER

GOODYEAR

AVIATION PRODUCTS

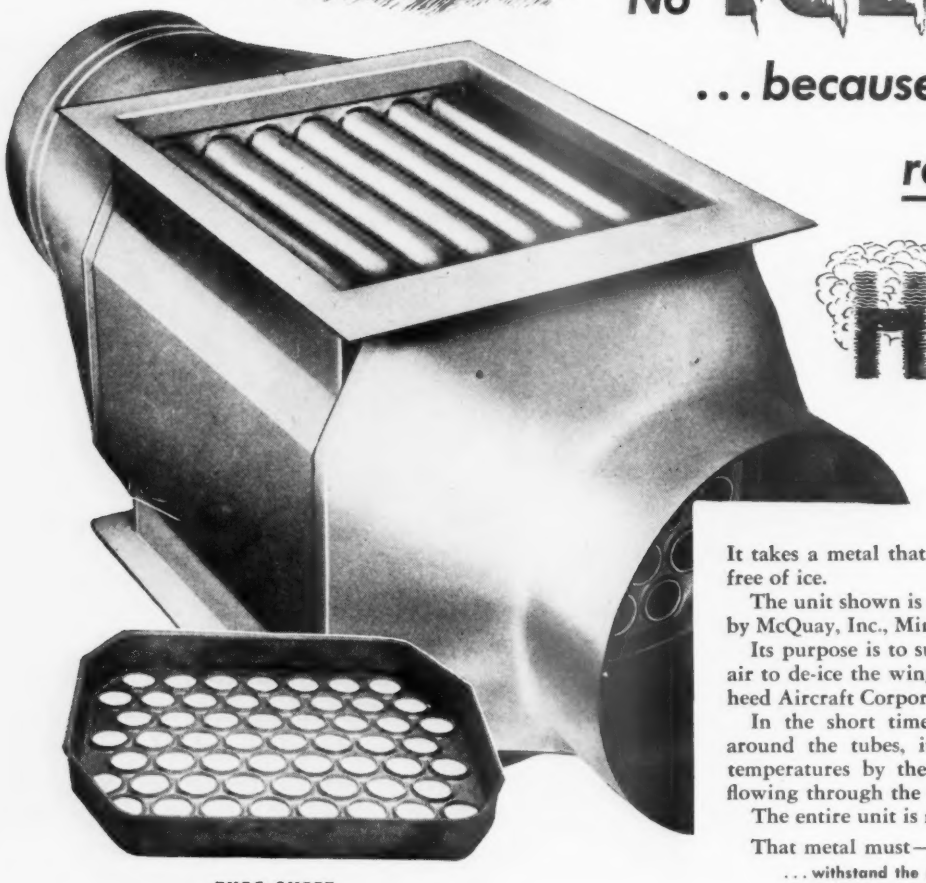
All-Weather, Ice-Grip, Griptred, Chemigum, Airfoam, Pliofilm, Pliofoam, Pliofoam, Iceguard—T.M.'s The Goodyear T. & R. Co.

9200
1156
v.5



No ICED Wings

...because a metal resists HEAT



TUBE SHEET

The entire heat exchanger is fabricated from Inconel sheet and seamless Inconel tubes, assembled by atomic hydrogen and Heliarc welding. In addition to welding, *working operations include* stamping *of the tube sheets;* drawing *of the transition ends; and* flanging *of the tube ends.*

TRANSITION END

It takes a metal that *resists* heat to keep wings free of ice.

The unit shown is a new heat exchanger built by McQuay, Inc., Minneapolis, Minn.

Its purpose is to supply large volumes of hot air to de-ice the wings of planes built by Lockheed Aircraft Corporation.

In the short time that cold air is rushing around the tubes, it is heated from sub-zero temperatures by the hot engine exhaust gases flowing through the tubes.

The entire unit is made of *one* metal.

That metal must—

- ... withstand the searing heat of exhaust gases without suffering serious oxidation
- ... stand up under the corrosive attack of high-octane exhaust
- ... permit a strong, yet lightweight, unit to withstand the vibrating stresses
- ... endure the thermal shock of sub-zero intake air and the hot blast of exhaust gases
- ... undergo all the difficult fabricating operations involved that must be employed to shape the parts and assemble them into a complete unit as designed.

The one metal offering all these properties proved to be *Inconel*—an Inco Nickel Alloy.

Before Inconel was tried, previous designs failed within 100 hours.

By redesigning the unit and making it entirely of Inconel, McQuay built-in the performance and life desired by Lockheed.

If you have a problem that heat-resisting Inconel might solve, let's hear about it. INCO Technical Service is ready to help you. For more information on Inconel, send for: *"Engineering Properties of Inconel."* The International Nickel Company, 67 Wall Street, New York 5, N. Y.

NICKEL INCO TRADE MARK **ALLOYS**

MONEL* - "R" MONEL* - "K" MONEL* - "KR" MONEL* - "S" MONEL* - INCONEL* - NICKEL - "L" NICKEL* - "Z" NICKEL*
Sheet ... Strip ... Rod ... Tubing ... Wire ... Castings ... Welding Rods (Gas & Electric)
* Reg. U. S. Pat. Off.

AERONAUTICAL ENGINEERING REVIEW

Published Monthly by the Institute of the Aeronautical Sciences, Inc., as a Part of the Services of the Aeronautical Archives

January, 1946

Vol. 5 **No. 1**

Copyright, 1946, by the Institute of the Aeronautical Sciences, Inc.

OFFICERS

President
Charles H. Colvin

Treasurer
Earl D. Osborn

Assistant to the President
George R. Forman

Secretary
Robert R. Dexter

Controller
Joseph J. Maltan

Past-Presidents
J. C. Hunsaker
Charles L. Lawrance
D. W. Douglas
Glenn L. Martin
Clark B. Millikan
T. P. Wright
George W. Lewis
James H. Doolittle
Frank W. Caldwell
Hall L. Hibbard
Hugh L. Dryden
R. H. Fleet

Vice-Presidents
W. A. M. Burden
Leroy R. Grumman
I. M. Laddon
Arthur E. Raymond

Executive Vice-President
Bennett H. Horchler

Council
Lester D. Gardner, *Chairman*
P. R. Bassett
Rex B. Beisel
George W. Brady
William K. Ebel
Sherman M. Fairchild
Charles Froesch
R. Paul Harrington
C. S. Jones
Otto E. Kirchner
John C. Leslie
Alfred Marchev
Elmer A. Sperry, Jr.

Pacific Coast Executive
William H. Dudley
6715 Hollywood Blvd., Hollywood 28, Calif.

SUBSCRIPTION RATES

Aeronautical Engineering Review: United States and possessions, 1 year, $3.00; single copies, $0.30. Foreign countries including Canada (American Currency Rates), 1 year, $3.50; single copies, $0.35.

Journal of the Aeronautical Sciences: United States and possessions, 1 year, $7.00; single copies, $0.70. Foreign countries including Canada (American Currency Rates), 1 year, $9.00; single copies, $1.00.

Entered as second-class matter at the Post Office, Easton, Pa., April 29, 1942. Acceptance for mailing at a Special Rate of Postage as provided for in the Act of August 24, 1912.

Publication Office: 20th & Northampton Streets, Easton, Pa.

Editorial Office: 2 East 64th Street, New York 21, N.Y.

Notices of change of address should be sent to the Institute at least 30 days prior to actual change of address.

Statements and opinions expressed in the Aeronautical Engineering Review are to be understood as individual expressions and not those of the Institute.

CONTENTS

Cover Illustration

Dynamic balancing machine with aerodynamic screen, used by Hamilton Standard Propellers Division of United Aircraft Corporation in studying propeller-balancing problems.

Articles

Simplified Design for Low-Cost Airplanes . . . . . Alfred Marchev 5

Glass Laminates and Their Application to Aircraft Structures . . . G. B. Rheinfrank, Jr., and W. A. Norman 10

Fatigue Failures of Aircraft Parts—Their Cause and Cure . . . . . Daniel M. Davis 15

Reviews

Periodicals 51

Government Publications 89

Books 101

General Marshall's Report: The Winning of the War in Europe and the Pacific
Aviation Facts and Figures, 1945
The Wings of Warfare
The Book of Miles Aircraft
Aviation
Handbook of Meteorology
Dynamics of Engines
War Neuroses
Aircraft Production Design
Middle East 1940–1942

House Organs and Catalogues 109

From the Industry 115

General

Institute News 25

Personnel Opportunities 41

Source Material 83

Index to Advertisers 129

George R. Forman, *Editor*

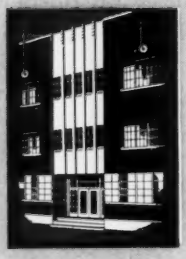
Russell F. Rogers, *Manager*

Harris F. Reeve, *Managing Editor*

Associate Editors: Gail Wadro, Bemeice H. Jarck, Edward G. Ingram

engineers and builders of oil hydraulic equipment

Since 1921



Vickers has been developing, improving and manufacturing oil hydraulic equipment since 1921 . . . five years before Lindbergh flew the Atlantic. In the 24 years that we have been building and applying hydraulic pumps and controls, our organization has accumulated a background of experience that has been invaluable in reaching the correct solution to many difficult problems in aircraft hydraulics.

Today, Vickers has the most extensive line of aircraft hydraulic pumps and controls . . . is the country's largest builder of precision oil hydraulic equipment.

Vickers Incorporated is entirely American-owned and has never been a subsidiary of, or associated with, any foreign company.

"Hydraulics" has been our business since long before the war began . . . it will continue to be our principal business.

VICKERS Incorporated

1414 [illegible] BLVD., DETROIT 11, MICH.

Simplified Design for Low-Cost Airplanes

ALFRED MARCHEV*

Republic Aviation Corporation

Introduction

A substantial quantity of airplanes can be sold for personal use *if* we are able to sell them at popular prices. This is a large "if." How are we to achieve low-cost manufacture of personal planes without a huge volume of sales? In attempting to answer this question, I may be disclosing "trade secrets." True, what we are doing along these lines at Republic will be indicated. But I do not consider this a trade secret. Such discoveries belong to the art and to the industry, and the furthering of the art and the industry will help my organization and others.

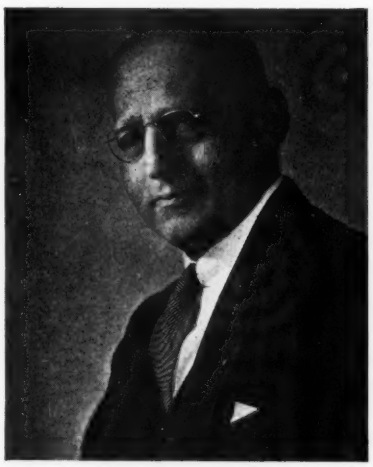
Low-cost manufacture can be achieved without huge volume by simplicity in design of the airplane. Facts must be faced, and some engineering traditions must be disregarded. Certain things have been done and certain traditions have developed because conditions have prompted engineers to work in certain channels and these have been costly.

Some releases to the newspapers give the impression that many aircraft companies have considerably reduced their cost of production. The old average of $10 per lb. has now been reduced to $8.00, $7.00, even $6.00 per lb.—a reduction of 20, 30, and 40 per cent. Yes, this is a great accomplishment in the midst of war production, where the miraculous meeting of impossible production schedules has had to be considered more than the costs of that production. But why is $6.00 per lb. a good cost? The aircraft industry has achieved quantity and performance when these were desperately needed, but we have not yet achieved low-cost design. Cost reductions are just beginning. Perhaps $1.00 per lb. is the right price.

Growth of the Industry

The aircraft industry has gone through four stages in its brief history in this century. In the first stage, man learned to fly. It didn't make much difference how fast, how high, how far; the important thing was that he stayed in the air for more than just a jump. In this stage, we found out how to make a flyable airplane, and we have steadily progressed in aerodynamics ever since.

The second stage was brought on by World War I. Airplanes that had been



designed experimentally and had been built in small quantities per model were put into mass production. But this production was still of experimental models, from prototype designs, of wood and cloth construction, and of many intricate small pieces.

In the third stage, after World War I, it was learned that wood and cloth were not so desirable as metal for aircraft. We therefore did the logical thing and replaced wood parts with metal parts. This replacement was not so easy as it sounds. It took 10 years to learn how to make metal structures as light as the old wood and cloth structures had been.

In this same third stage, the industry still worked largely without tools and equipment and assembled many small hand-made pieces to make an airplane. The engineer set out to design a new airplane, and he included in his thinking the ease of manufacture. The shop people had always pleaded for a design they could make. They had no tools and no equipment, and they begged for designs that required no special tooling. The engineer obliged and designed a tubular-steel welded fuselage, cloth-covered, with a wing of cloth-covered metal and wood. From the engineer's standpoint the design was a masterpiece. It flew, it performed, and the shop could make it without tools or equipment.

All the shop needed was a hacksaw, a jack-knife, a welding torch, a sewing needle, and a dope brush. When they built a good airplane and sold two, they needed two hacksaws, two jack-knives, two welding torches, two sewing needles, and two dope brushes. If 100 of this model were made, these items were multiplied by 100. The individual detail parts were small enough to be made by hand and to be assembled by hand without much assistance from jigs and dies and other special tooling. Because these parts were so designed, there was an enormous number of them per airplane.

In this same period, before World War II, we were also rather vain about who could do a job in an airplane factory. When, after 20 years, I returned to the industry at the time of Pearl Harbor, I found that when an aircraft plant wanted to hire a janitor, they could not. There were no janitors who had previously worked in an aircraft plant, and therefore none fit for this specialized work! It was the same way with toolmakers and tool designers.

The fourth stage, World War II, was outstanding for its accomplishment in large-scale production. There was no time to arrive at a production design, and, as in the days of World War I, the designs were experimental and were put into mass production as they were. Under these conditions, it is all the more remarkable that we have achieved such production.

Postwar Manufacturing Procedures

Today we seem to be entering a fifth stage. Where do we go from here? It appears that the people who were manufacturing in prewar days, in the way I have described, are planning to return to that way of designing and manufacturing after the war. If that is true, it is inexcusable. Tradition and human inertia will hamstring the industry.

If the industry is to survive, it will have to start from scratch. The best positive answer is simplicity in design for low-cost manufacture. Thus, if there is any potential market at all, airplanes can be sold at competitive and economical prices, and air-minded people can afford to buy.

Every time I go through an airplane plant I am impressed by the large sheets of aluminum, drilled full of holes and the holes being filled with rivets. The reason for this time-consuming and cumbersome arrangement is that the airplane has been designed of the same old small parts, too many of them. A page must be taken from the experience of the automobile people with design simplicity. Twenty or twenty-five years ago, a generator cost $120. Today, an equivalent generator costs $12, in spite of labor rates being two or three times higher than they were then. This

Presented at the New York Section Meeting, I.A.S., New York, April 23, 1945, and at the Light Aircraft Meeting, I.A.S., Detroit, October 4–5, 1945.

* President.

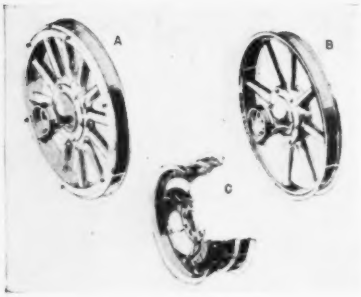


Fig. 1.

dramatic reduction indicates that the way to lower cost is not through lowered wages but through simplified design. The generator has gone through exactly this kind of development.

Another example from the automotive field is the automobile wheel. Fig. 1 shows an early wheel with wooden spokes (A). Wood did not lend itself to mass production and was therefore expensive to make. The automotive engineers recognized this and designed wheel (B). It was an improvement, since metal spokes could be produced in quantity for less than wooden spokes. But the real answer came when they made a simplified sheet-metal wheel (C) used today. True, the special tools for production of this modern wheel are more expensive, but even in small quantities such a design is cheaper to manufacture.

At the present time, most of the aircraft industry is committed to a type of airplane design that is inefficient to produce. As an indication of how deep and common the rut is, Fig. 2 shows wrecked Japanese airplanes. It will be noticed that their construction is practically identical to that of German, British, and American planes. It can hardly be determined what nation has designed an airplane, so similar are these conventional designs.

Effect of Detail Part Design on Costs of Manufacture

Today's airplane manufacturing costs are distributed as follows:

Parts	Sub-assembly	Final Assembly	Total
20%	70%	10%	100%

The component parts are brought together as subassemblies; the assembling cost is 70 per cent of the total cost of manufacture. It would thus appear that the key to effecting major reductions in costs lies in the subassembly area rather than in detail parts. Yet the efforts of manufacturers to date, as reported in papers read before other organizations, have been concentrated on designing individual parts more simply. Shop departments have been called in to show the engineers how to do this, and what has been accomplished? A reduction of as much as 20 per cent in the cost of manufacturing these detail parts. This amounts to an overall reduction of only 4 per cent, the costs being distributed as follows:

Parts	Sub-assembly	Final Assembly	Total
16%	70%	10%	96%

Note that the same number remains; only their design has been simplified. Thus the cost of subassembly remains the same, and no major reduction in costs has been achieved.

If, on the other hand, the number of these parts is reduced by 80 per cent, so that instead of five parts there remains only one, two important reductions are effected. For one thing, the cost of parts manufacture is reduced from 16 per cent of the total to 4 per cent, there being 80 per cent fewer parts to make. Again, with fewer parts there is proportionately less subassembly work to do. In this illustration the subassembly costs would also be reduced by 80 per cent to 14 per cent of the total.

Parts	Sub-assembly	Final Assembly	Total
4%	14%	10%	28%

In addition to these savings, the cost of parts manufacture can further be cut in half by good designing and tooling. This would bring parts costs down to 2 per cent of the total. With these better and accurate parts, easy to assemble, subassembly costs may possibly be reduced to 10 per cent of the total, and final assembly costs to 8 per cent, or as follows:

Parts	Sub-assembly	Final Assembly	Total
2%	10%	8%	20%

The total manufacturing cost of the airplane would thus come down to 20 per cent of its present cost.

The Republic "Seabee" Amphibian

Thinking along these lines, we at Republic decided to try out this principle of simplified design. We had decided to make a small amphibian (see Fig. 3), developed by H. Spencer. Our

Fig. 3.

specifications for this airplane were sketched to include four passengers, a 185-hp. engine, all-metal (no cloth) surfaces, cruising an honest 100 m.p.h., with automobile comfort and interior. There was to be no sitting in canvas seats or clambering in and out like a contortionist. We wanted flaps for lower landing speed. The airplane would be an amphibian, for greater utility to the owner.

We boldly said that this airplane would list complete for $3,500. Setting such a price limit was, of course, exceedingly optimistic. The price was based on our conception of this amphibian as belonging to the Buick class, not the Ford.

From these specifications our engineers did a good job of designing such an airplane. But it was a rather conventional design. While it flew well and handled nicely on land and water, it cost $3.60 per lb. of air frame and would have to sell for $7,500. Except for the cost, everything was fine.

Fig. 2.

A $7,500 airplane cannot be sold for $3,500, but we were stubborn about our purpose and would not admit that this cost could not be brought in line. We had many conferences, out of which came a decision to see what could be accomplished by simplifying the design.

Design Simplification

All credit for what I am about to describe goes to our Engineering Department, particularly to our Stress Engineer, A. Boyajian. He did an outstanding and courageous job.

We chose the stabilizer of the amphibian to begin with, it being separate, distinct, and complicated. The original design is shown in Fig. 4. You will note that this is a good conventional structure, with the usual spars, ribs, and stringers. It is a fair example of simple though conventional design.

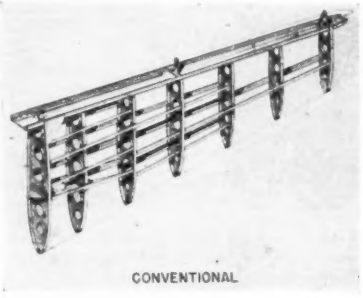


Fig. 4.

In our effort to simplify this design, we emphasized that there must be no increase in weight, and no decrease in strength or aerodynamic quality. Fig. 5 shows the redesigned stabilizer. This is a complete structure, lacking the skin. Compare this with the conventional structure shown in Fig. 4. Figs. 6 and 7 show the conventional and simplified stabilizers with their skins attached. The outline of each is the same, except for some beading on the simplified stabilizer. For a low-speed airplane this exterior beading is not objectionable. As a matter of fact, while this beaded skin is heavier, the beading has replaced other heavier structural members.

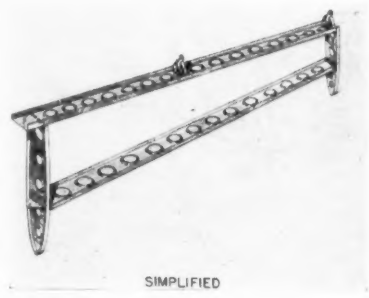
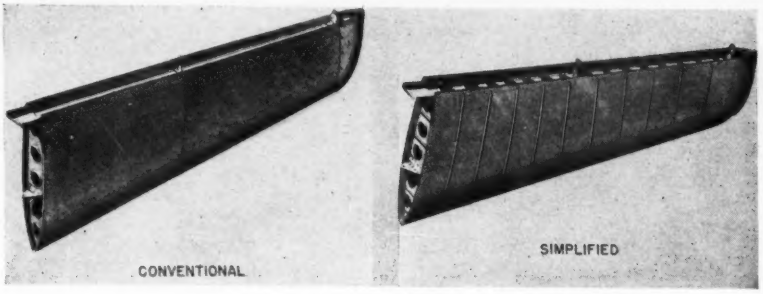


Fig. 5.



Figs. 6 and 7.

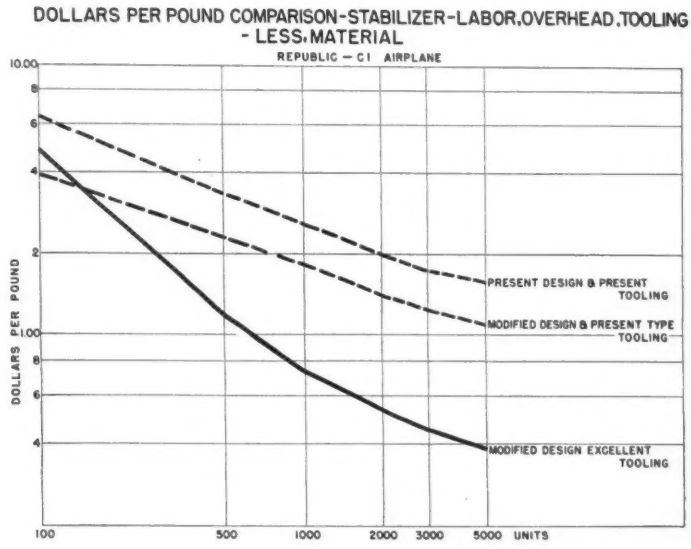


Fig. 8.

Compare the two designs from a cost point of view:

	Conventional	Simplified
Number of pieces	42	10
Weight (lbs.)	26	26
Fabrication (man-hours)	14.2	2.7
Number of rivets	521	161

There were two noteworthy reactions to the simplified design. The stress engineers did not know how to calculate the stress of this new structure. They said: "We think that it won't work, but we can't prove that, because we can't figure the stress. It's not in the book!" Then they said: "You are comparing fabrication time of 2.7 manhours with 14.2. The 2.7 figure is possible only with excellent tooling, and we can't afford such tooling without automotive volume of sales."

The latter reaction led to some careful estimating of the distribution of stabilizer tooling costs over 100, 500, 1,000, and up to 5,000 airplanes, with fair and excellent tooling, conventional and simplified design. The result is presented in Fig. 8.

Material costs are omitted, since they are the same under all conditions. The important and amazing fact is that excellent tooling pays for itself in less than 200 airplanes and from that point on is actually more economical than poorer tooling. The old cry—that you have to produce something like 5,000 units a day to reduce cost substantially—is a bugaboo.

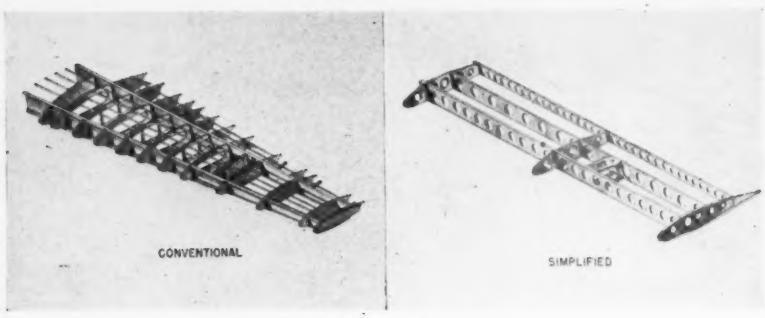
Wing Design

After the principle of simplified design had been applied to the stabilizer, we proceeded with the wing of this model to be sure that our success on the stabilizer was not freakish. The result of the redesign of the wing is shown in Figs. 9 and 10. Note the absence of ribs in the simplified structure. This was the key to simplifying the design.

The costs of manufacturing from these designs are compared as follows:

	Conventional	Simplified
Number of pieces	114	21
Weight (lbs.)	150	110
Number of rivets	2,627	882

These reductions were made possible partially because the design went to semicantilever and added a single strut support, but the lighter weight of the



Figs. 9 and 10.

simplified design includes that of the strut and fittings.

Once again the stress engineers were baffled. They said: "You save a lot of money on paper, but we don't think it will work. We can't find anything in the book to calculate the stresses on it." So we proceeded to test it, using a 50-in. test section (Fig. 11) to determine whether the wing would carry the required load.

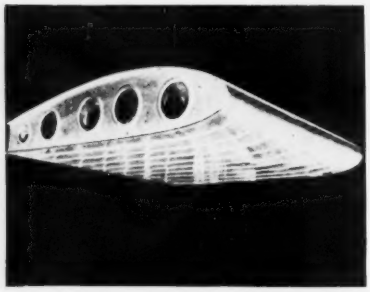


Fig. 11.

Wing Tests

The conventional whiffle-tree test was difficult in this case because the new structure had no ribs to support the skin. The results were not conclusive, and a stress engineer, A. Boyajian, devised a new method of test. This new method uses pressure reactions, eliminating the elaborate whiffle-tree and substituting rubber bags inflated inside the structure. The two methods of testing the wing are illustrated in Figs. 12 and 13.

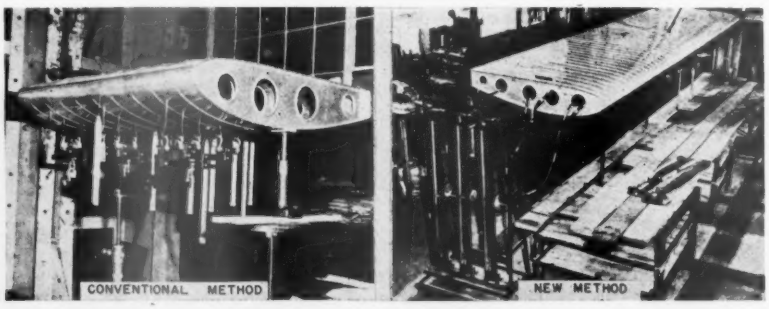
The tests showed that the wing took a load of 115 per cent, while the stabilizer, also tested, took 110 per cent. Further, the wing was four times as strong in torsion as C.A.A. requirements and was 70 per cent as rigid as the Thunderbolt wing. The new wing of simplified design actually weighs, per square foot, almost the same as the old-style wood-and-canvas wings.

Hull Redesign

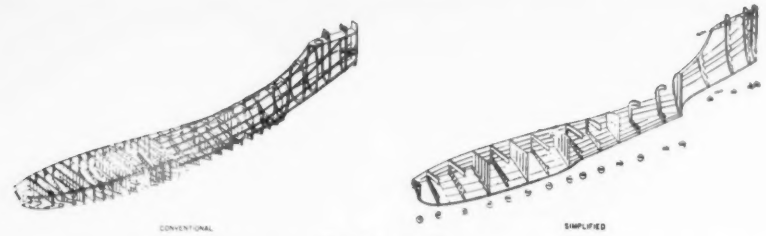
Still not satisfied with our application of the principle of simplified design, we redesigned the hull of the amphibian. A comparison of the two designs is shown in Figs. 14 and 15. The simplified design of the hull reduced the number of parts from 357 to 44. When we had reached this point of proving our theory, we felt pretty good about it. If it works on a stabilizer, if it works on a wing, and if it also works on a hull, it should work when applied to the entire airplane. Moreover, if all this is practical on a 100-m.p.h. airplane, it should be equally true for a 400-m.p.h. airplane, like the Thunderbolt. While weight per square foot must be much higher for a heavily loaded fast airplane, the costs per pound should be much the same.

Thunderbolt Fin Redesign

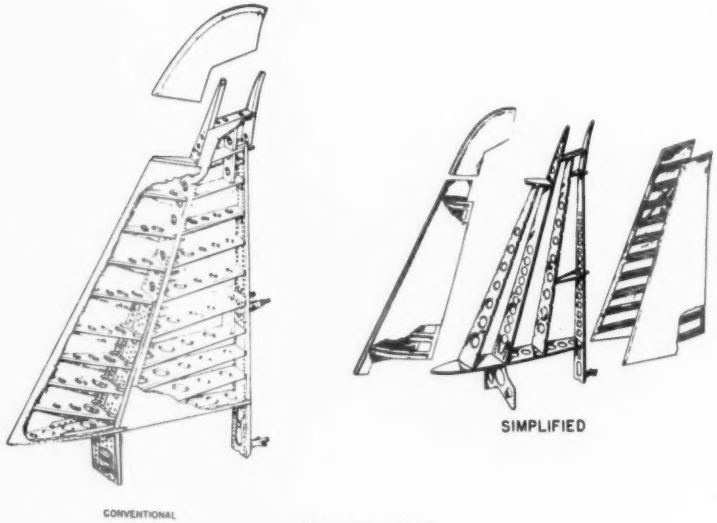
The Thunderbolt fin, before and after redesigning, is shown in Figs. 16 and 17. It will be noted that high-speed conditions in the Thunderbolt made outside beading impossible. A double skin, with the beading on the inside skin, was designed. Comparison of the basic data is as follows:



Figs. 12 and 13.



Figs. 14 and 15.



Figs. 16 and 17.

	Conventional	Simplified
Number of pieces	94	25
Weight (lbs.)	36.2	36.2
Fabrication (man-hours)	113	13.5
Number of rivets	1,037	564

This fin was now built and static tests were completed. This new fin proved to be 20 per cent stronger than the original conventional fin. It was 10 per cent stronger in stiffness and bending. It was important to note that the new fin maintained a smoother surface under all loading conditions.

Small Units

In addition to redesigning complete assemblies, like the wing and stabilizer, the principle was applied to some small units. One was the nose ribs on the Thunderbolt P-47 wing, shown in Fig. 18. Notice that it was conventionally made up of four pieces, which, with their assembly, took 42 min. to make. It used 39 rivets, and conventional tooling for the part took 140 hours. After redesigning there was only one piece, which took 5 min. to manufacture. Good tooling will require 310 hours, more than twice the present tooling cost, but the new tooling will still pay for itself in only 280 airplanes. Once again the old adage about automotive volume has proved on examination to be untrue.

Another objection from the engineers appeared at this point. When it was suggested that they should then proceed to design all airplanes simply, they said: "You can't make such parts without expensive tools. How will the shop build the first prototype airplane?" To answer this objection one such part was made by hand in the shop. It took 8 hours to make and assemble from the old design, and only $3\frac{1}{4}$ hours from the new design! It was the same story: one part is less costly than several components and the assembly of them.

The principle was also tried on an aileron horn fairing, shown in Fig. 19. This design calls for three parts to be welded together. It would be satisfactory to weld this part for the one prototype airplane, until production is started and tooling provided. However, the engineers had designed the part as a welded assembly and expected the shop to continue to weld the three parts together in production quantities. With good tooling and making the part in one piece, the comparison is clear:

	Conventional	Simplified
Number of pieces	3	1
Fabrication (man-min.)	180	4
Tooling time (hours)	468	1,450

While the new tooling is much more costly, it still pays for itself in 540 airplanes.

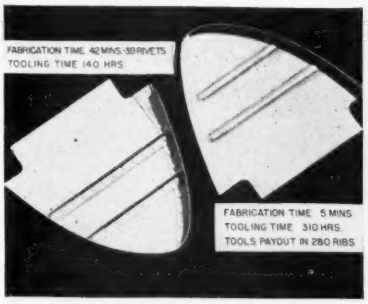

FABRICATION TIME 42 MINS. 39 RIVETS
TOOLING TIME 140 HRS.
FABRICATION TIME 5 MINS.
TOOLING TIME 310 HRS.
TOOLS PAYOUT IN 280 RIBS

Fig. 18.

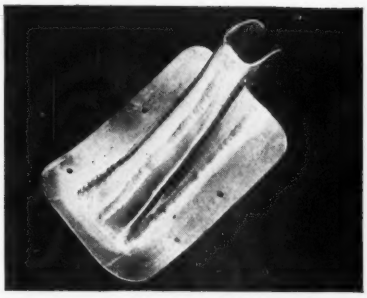


Fig. 19.

Conclusions

There are enough facts here, and we have done enough research in our plant, to indicate that the same principle applies to any type of airplane, whether personal, fighter, large transport, or bomber. The only difference in the cost of applying this principle is the difference in tooling costs, these depending upon the type of tooling you can invest in. By and large the manufacture of fewer parts per airplane will cost less than the manufacture of more parts, regardless of tooling or method of manufacturing.

Costs of personal airplanes depend on more than just the air frame. We might simplify the air-frame design and still fall down in the market because the engine and the equipment items were too costly. During the war, engines have been sold for as high as $20 per hp. (Horsepower, by the way, is not a good index—displacement would be better.) Manufacturers of small engines, for personal planes, say it will be a miracle if they can get their price down to $6.00 or $5.00 per hp. I am not an engine manufacturer, but I know what can be done with metal conversion. I know that since the automotive engines sell for 20 cents per lb. the aircraft engine manufacturers ought to be able to make them for $1.00 per lb. I am convinced that, with proper equipment, aircraft engines will be produced for $2.00 or less per hp.—unless the engine manufacturers lack the courage to invest in good equipment. Possibly, they are also laboring under the illusion that you have to make 5,000 engines a day to bring down costs.

Engine manufacturers should also consider that unless personal airplanes are sold at reasonable prices they will not be sold, *and* the engine manufacturer will have no market for his product. The price of the engine has much to do with the price of the airplane. Thus the engine manufacturers must help by reducing their own costs.

Another uneconomic situation exists in the field of aircraft equipment. The ammeter on an automobile, made in large quantities, costs only 11 cents. Actually, it is not an ammeter; it is merely an indicator of battery charge or discharge. That is all the driver is interested in. Now, when the engineers design an ammeter for airplanes, what do they do? They specify accuracy of $\pm\frac{1}{2}$ per cent. The instrument must operate at 67° below zero and 130° above, etc., etc. The instrument maker comes back and says: "We have done a marvelous job. We can make that kind of a precision instrument for only $11." And yet, like the automobile owner, we are only interested in knowing whether the battery is charging or discharging.

Still another thing for the engineers to watch is passenger comfort and sales appeal. The aircraft engineer will have to take into account the sales requirements of ourselves and our women folk. Women will buy many airplanes in the future, and an airplane that is merely a good flying machine will not sell to these customers.

We engineers have a job to do—we have a great opportunity to build a great private plane industry. Let's have courage and vision and we will do tomorrow what seems impossible today.

Changes of Address

To facilitate the prompt receipt of copies of the JOURNAL and REVIEW, members and subscribers are requested to give the editorial offices 30 days' notice of any change of address.

Notices should be sent directly to the Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N.Y.

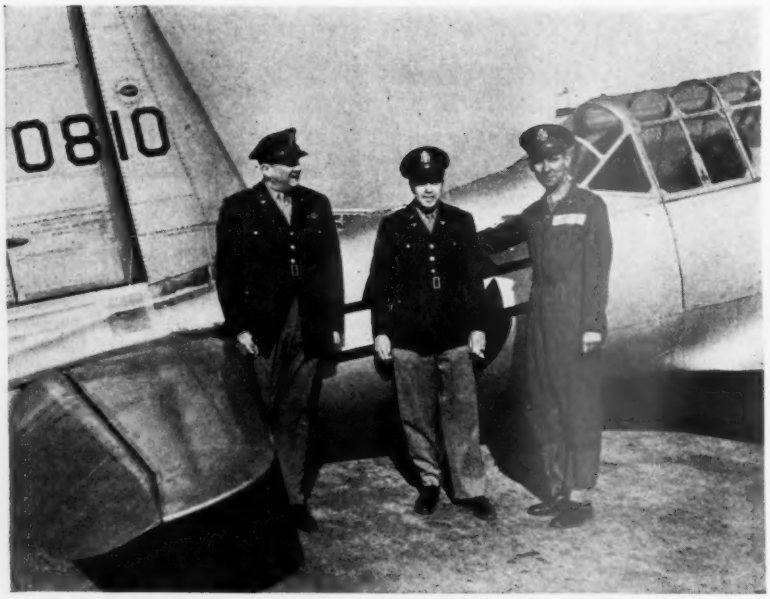
Glass Laminates and Their Application to

G. B. RHEINFRANK, Jr.,*

and

W. A. NORMAN*

Wright Field



Left to right: Col. P. H. Kemmer, Capt. W. A. Norman, and Capt. G. B. Rheinfrank, Jr., standing in front of the first glass sandwich fuselage—BT-15.

Introduction

The Engineering Division of the Air Technical Service Command is constantly striving to improve the present-day airplane. Aircraft designers have long recognized that before substantially improved performance can be attained, the exterior surfaces of aircraft must be smoother and more stable. A 10- to 20-m.p.h. increase in high-speed performance tests of one pursuit aircraft was attained by smoothing up its exterior surfaces. The limitations of conventional sheet stringer semi-monocoque design are well known. Rivet heads, skin laps, and "oil canning" greatly impair the smoothness of conventional structures, while the multiplicity of criss-crossing metal structural members and thousands of rivets complicates the fabrication.

In addition to work on thick plate structures of conventional materials, engineers of the Air Technical Service Command undertook the development of new materials and structural design using low-pressure reinforced laminates. Research along these lines has resulted in a threefold development in aircraft construction. A new basic structural material, a new low-density core material, and new low-pressure laminating resins, are combined in greatly simplified sandwich-type aircraft structure.

Presented at the Los Angeles Meeting, I.A.S., Los Angeles, August 16–17, 1945.

* Captains, Engineering Division, Air Technical Service Command.

A New Structural Material

Work on the development of a new structural material that would be suitable for aircraft began in December, 1942, and as a result of this work the first glass sandwich fuselage was built and flight-tested by the Aircraft Laboratory of the Air Technical Service Command on March 24, 1944. On a strength-weight basis this fuselage was 50 per cent stronger than the standard metal fuselage and 80 per cent stronger than the standard wooden fuselage.

At the present time the principal aircraft structural materials in use are steel, aluminum, magnesium, and wood. The high strengths attained with the metals are the result of years of research in crystalline structures. Now attention is turning to the possibilities of high-strength fibrous laminates as a structural material. Fibrous structures are not by any means a recent development, as nature seems to have settled on the use of this type of construction thousands of years ago. A tree consists of cellulose fibers bonded together with lignin. In the animal kingdom, too, nature has selected fibrous structures where high strength-weight ratio is required. For example, a bird's wing is probably one of the most efficient load-supporting structures for its weight known to man. But since these were designed by nature to do a specific job, it is not surprising that their strength cannot always stand up for jobs that they were not designed to do. The Army Air Forces found that wood, which is hygroscopic, was not a satisfactory structural material for combat aircraft, which must operate in weather conditions encountered in all parts of the world. As a result, engineers must look to a synthetic material to meet the rigid requirements of combat aircraft.

Plastics

Attention was directed to the use of plastic materials. Since 1909 when the first synthetic plastic material, phenol formaldehyde, was produced, the use of these materials has spread into all fields of industry. They are found in such common articles as telephones, radio housings, buttons, and combs. However, little use had been made of these plastics in structural applications.

While these materials had many desirable characteristics, they lacked sufficient strength, impact resistance, and dimensional stability to be considered for primary aircraft structures. Engineers already had experience with reinforced concrete, where steel bars were used to add tensile strength, as well as other valuable properties, to concrete, so it was natural to add high-strength fibers to plastics to gain the necessary characteristics which were lacking.

Glass Fiber

Many different types of fibers can be used as reinforcing agents in plastic laminates, including cotton, linen, rayon, silk, and glass fibers. Several factors led to the selection of glass as the most ideal fiber. Glass fibers have a substantially higher strength-weight ratio than other fibers, do not absorb moisture, resist acids, are dimensionally stable, and have high temperature resistance. These glass fibers can be produced in continuous filaments, and their physical properties can be closely controlled, making possible a uniform laminate.

While Fiberglas has been successfully incorporated with high-pressure resins for nonstructural application, one of the most promising developments is combination of glass fiber with new low-pressure laminating resins. These resins contain no volatile matter and will cure without pressure. The combining of these new resins with glass fibers, which possess maximum strength in the uncompressed condition, makes possible the elimination of heavy, costly,

high-pressure equipment. The low-pressure laminating technique is thus particularly suitable to the fabrication of large, curved sections peculiar to aircraft construction, formerly impracticable with high-pressure techniques.

The basic procedure involved in laminating glass fiber by low-pressure techniques is fundamentally simple. The cloth is impregnated with resin using an automatic coating machine. Layers of the impregnated cloth are laid in inexpensive molds conforming to the finished contour of the part as shown in Fig. 1. These molds can be made of plaster, wood, or sheet metal and may be used indefinitely.

After the required plies are built up, the excess cloth is trimmed off. The part is then covered with a rubber or polyvinyl alcohol blanket, a vacuum is drawn, and the assembly is ready to be cured. The part after being cured for several minutes at about 250°F. is completed.

The glass laminate (weighing the same as magnesium) is actually composed of 60 per cent glass fibers and 40 per cent bonding resin by weight. Unlike the common window glass, which shatters easily, the glass cloth in the laminate is made of microscopic high-strength filaments possessing entirely different physical properties. A 0.45-cal. bullet fired from 25 ft. directly at a $^1/_4$-in. panel will rebound like a rubber ball. These filaments are so fine that a $^1/_8$-in. diameter glass ball will produce a continuous fiber 98 miles long.

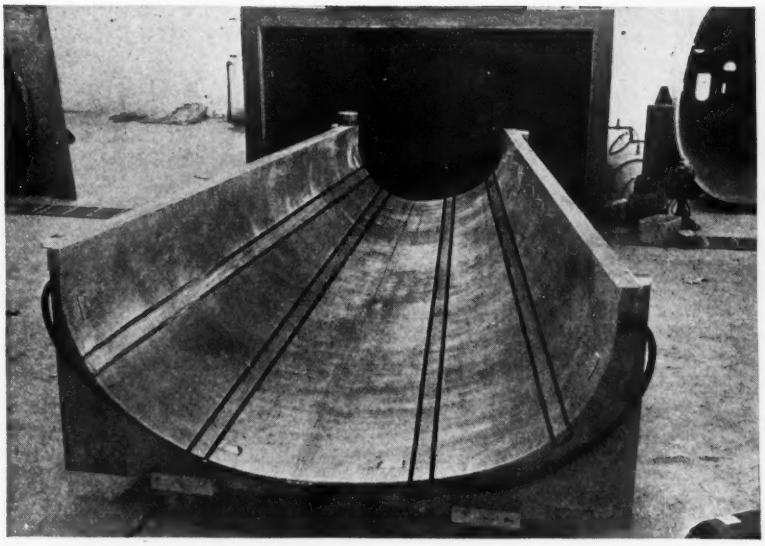


Fig. 1. Typical metal mold.

Physical Properties of Glass Laminate

Physical properties of the present glass laminate when compared to the properties of conventional aircraft structural materials can be briefly summarized as high strength—low elongation—low modulus. The tensile and compressive strength properties are comparable to 24ST aluminum on a strength-weight basis, while the modulus of elasticity, bearing strength, and elongation are lower.

Table 1 gives a comparison of strengths obtained with glass cloth laminates as compared to 24ST aluminum alloy. Strength values as listed were obtained on $^1/_8$-in. laminate in laboratory tests. Actual design values for glass laminate, particularly in thinner sections, are lower and must be determined by test.

Table 1. Physical Property Comparison
Comparative Specific Strengths of Cross-Laminated Glass Cloth and Aluminum

	1 Typical Glass-Cloth Laminate	2 Specific Strengths Glass-Cloth Laminate	3 Specific Strengths 24ST Aluminum	4 Aluminum Alloy 24ST Sheet	5 Specific Value
Specific gravity, s.g.	1.75	1.75	2.77	2.77	.....
Ultimate tensile strength, u.t.s.	47,000 lbs. per sq.in.	27,000	22,400	62,000 lbs. per sq.in.	$\frac{\text{u.t.s.}}{\text{s.g.}}$
Ultimate compressive strength, u.c.s.	45,000 lbs. per sq.in.	25,000	22,400	62,000 lbs. per sq.in.	$\frac{\text{u.c.s.}}{\text{s.g.}}$
Modulus of rupture, u.f.s.	65,400 lbs. per sq.in.	21,400	8,100	62,000 lbs. per sq.in.	$\frac{\text{u.f.s.}}{(\text{s.g.})^2}$
Modulus of elasticity (buckling) $E \times 10^6$	2.2 lbs. per sq.in.	0.41	0.495	10.5 lbs. per sq.in.	$\frac{E}{(\text{s.g.})^3}$
Modulus of elasticity (deflection) $E \times 10^6$	2.2 lbs. per sq.in.	1.25	3.8	10.5 lbs. per sq.in.	$\frac{E}{(\text{s.g.})}$

[a] Average values of Owens-Corning Fiberglas Corp. Report No. 328 for cross-laminated OC-64 cloth with several types of resin. Column 1.
[b] Specific values computed as shown in Column 5. Items 4 and 5 take into consideration the increased thickness allowable for equal weight sections of lower density material.
[c] *ANC-5*. Column 4.

The Sandwich-Type Structure

In selecting the type of structure which would most efficiently utilize the strength properties and overcome the lower modulus of the material, the sandwich-type structure was the logical choice. The inherent rigidity of the sandwich-type structure having the high-strength faces stabilized by a low-density core compensates for the lower modulus of this material and allows it to develop a large portion of its ultimate strength in compression.

In conventional sheet stringer semimonocoque structures the greater part of the load is carried by the stringer and the sheet immediately adjacent, while the rest of the sheet contributes only a small amount of its potential strength in compression, its chief function being to aid in carrying the torsion loads.

In the sandwich-type structure the faces carry all of the direct stress, while the core merely stabilizes the faces. In comparing the load material it would appear that much higher specific stresses must be carried in the sandwich faces than in the working material of the semimonocoque design. This fact, however, is offset by the elimination of interior supporting elements possible in the sandwich-type structure. Additional weight-savings may also be realized in sandwiches, since thermal and acoustical insulation is a part of the structure.

Considering the relatively low modulus of the present fiber glass laminates, it is evident that these laminates will have to be used in sandwich-type structure

Fig. 2. Glass honeycomb core.

if they are to compete with conventional metal aircraft structure on a strength-weight basis. It is fortunate, therefore, that glass laminates can be easily fabricated into sandwich-type structures, since, unlike metals, Fiberglas laminates prior to being baked are relaxed and will conform to any given curvature without the use of excessive pressures. Thus a Fiberglas sandwich can be made by simply placing impregnated plies on both sides of a low-density core material and baking under vacuum pressure. In this operation the laminating resin performs two functions—that is, cementing the glass fibers together and gluing the cemented fibers to the core material.

Until recently, only wood has been employed in sandwich-type structures. The well-known British Mosquito employs both plywood faces and a balsa core. While the merits of this type of construction have been recognized by the Army Air Forces, the use of wood in combat aircraft operating in all parts of the world was not considered advisable. The possibilities of metal-faced sandwiches (steel, aluminum, or magnesium) were overshadowed by the difficulties encountered in their fabrication.

Metal-Faced Sandwiches

The principal difficulties encountered in metal-faced sandwiches are forming sections of compound curvature, obtaining adequate bond of the face to the core, and the joining of large sections. For these reasons the application of both wood and metal sandwiches has been limited in the United States. However, glass cloth, a high-strength facing material providing adequate strength and durability, also possesses outstanding fabricational possibilities.

The only core material available in quantity in 1943 was balsa wood. Although balsa possessed adequate strength properties, it was not considered satisfactory from a durability standpoint, was not uniform, and was difficult to obtain. The next step in the development of a satisfactory sandwich aircraft structure was the substitution of some other material for the balsa wood core. This involved the development of a low-density synthetic core material having adequate strength, low moisture absorption, and dimensional stability. It was essential that the density and properties of the material be uniform and controllable in manufacture.

The primary function of this low-density core material is to stabilize the thin high-strength faces so that they will develop a substantial portion of their ultimate compressive strength without buckling. To accomplish this, the core must be strong enough in tension normal to the surface so that there is no buckling of the faces through tension failure in the core itself. Further, compression strength of the core material normal to the faces must be sufficient to resist local loads usually encountered in service because of rough handling. The necessary compressive strength of the core material parallel to the faces is governed by the modulus of the material. The relationship of the compressive modulus to the compressive strength of the core must be such that the core will not fail before the faces develop their maximum strength.

The shear rigidity of the core must be enough to hold the entire sandwich combination stable until the faces develop their full strength. A sandwich, having a soft rubber-like core, would fail prematurely. A satisfactory core material must not be brittle or granular, since materials with these properties possess poor impact and vibration characteristics. Sandstone-type materials fall into this category.

Synthetic Core Materials—Minimum Physical Properties

In order that synthetic core materials would satisfactorily fulfill the requirements as outlined, it was necessary to establish minimum physical properties based on preliminary experimental testing. These properties as established by the Air Technical Service Command are as follows:

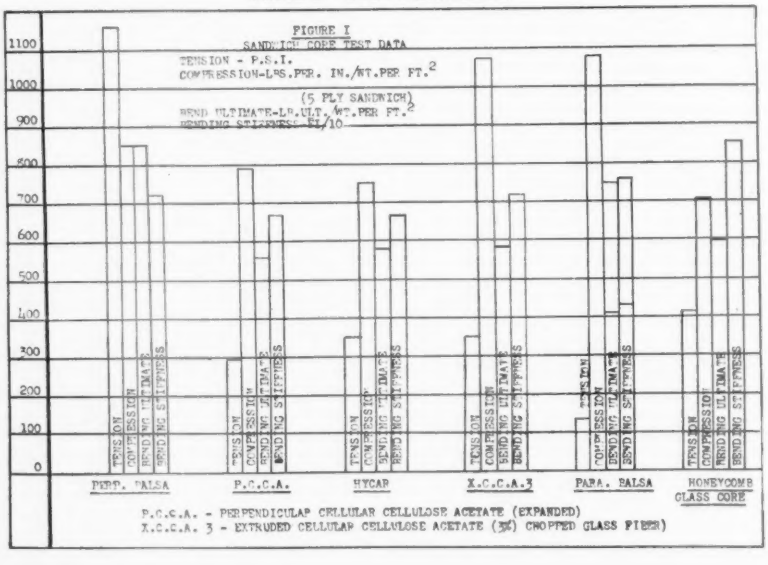
I. Specific Mechanical Properties, Room Temperature

(a) Specific tensile strength flatwise, minimum—2,000.

(b) Specific compressive strength flatwise, minimum (at fracture or sudden yielding, or at 2 per cent strain, whichever is lowest)—1,000.

(c) Specific modulus of rigidity associated with shear distortion in planes parallel to the edge plane, minimum—40,000.

Table 2—Core Properties.



(d) Specific shear strength in whichever direction is the weakest in shear, minimum—1,000.

(e) Compression and tension edgewise (lengthwise or crosswise in the plane of the sheet) strain before any type of failure occurs, minimum—2 per cent.

(f) Type of compression failure—no crumbling or disintegrating.

(g) Impact strength (falling ball impact test), minimum—$1^1/_2$ ft.lb.

II. Specific Gravity

(a) If the material has the specific properties given under heading I, a specific gravity in the range of 0.05 to 0.15 is acceptable. A minimum of 0.09 is preferred because of the actual or absolute values of the mechanical properties obtainable. Lower specific gravity materials with properties equal to those specified above for 0.09 or higher specific gravity materials would, of course, be better, if possible of attainment. (Multiply specific strength values given above by specific gravity of material to obtain required properties in pounds per square inch. Note that impact strength and strain values are not specified in this form.)

The general classifications of cores investigated are as follows:

(1) Foamed thermosetting (phenolics, ureas, or copolymer) resins.

(2) Foamed thermoplastic (cellular cellulose acetate, polystyrene) resins.

(3) Foamed rubbers.

(4) Foamed glass.

(5) Foamed calcium alginate.

(6) Gridded cores (honeycomb or square filled grid).

(7) Impregnated fibrous cores.

(8) Natural (balsa wood or cork).

Investigation of synthetic core materials conducted by the Air Technical Service Command indicated that of the cores tested the cellular cellulose acetate, hycar, and honeycomb glass cloth cores were the most promising. Table 2 shows comparative properties of these core materials. Fig. 2 illustrates the glass honeycomb core material.

Suitability of Laminated Materials for Aircraft Structures

The Air Technical Service Command, through work conducted at the laboratories at Wright Field and through contacts with the industry, has been investigating the suitability of these laminated materials as applied to aircraft structures. Since the only conclusive proof of a material's suitability comes from testing actual structural components of aircraft, several parts of existing aircraft were designed, built, and tested by the Air Technical Service Command. The most significant result of this investigation came from the work on the BT-15 fuselage. This fuselage was considered a typical structural component that could be conveniently service-tested on existing airplanes. The first fuselage section, fabricated of glass cloth balsa sandwich, was flown on March 27, 1943. As previously stated, static tests on one of these sections indicated that on a strength-weight basis it was 50 per cent stronger than the metal fuselage and 80 per cent stronger than the wooden fuselage. These tests were the first conclusive indication that glass fiber laminates could be used for primary aircraft structures. Work on the development of synthetic cores started soon after this initial project, and on February 15, 1945, a BT-15 fuselage of all-glass honeycomb core sandwich construction, built by the Plaskon Division of Libbey-Owens-Ford Glass Company, was static-tested. This fuselage is shown in Fig. 3. Tests on this fuselage proved that its strength was comparable to the original glass cloth balsa fuselage, while its weight was somewhat lower. Strength-weight comparisons of the standard metal and wood fuselages and the two glass sandwich sections are given in Table 3. Of significance in comparing these fuselages was the fact that the standard fuselage was severely buckled below 100 per cent of design ultimate load, while the glass sandwich fuselages showed no sign of buckling at 180 per cent of the same design load as shown in Figs. 4 and 5.

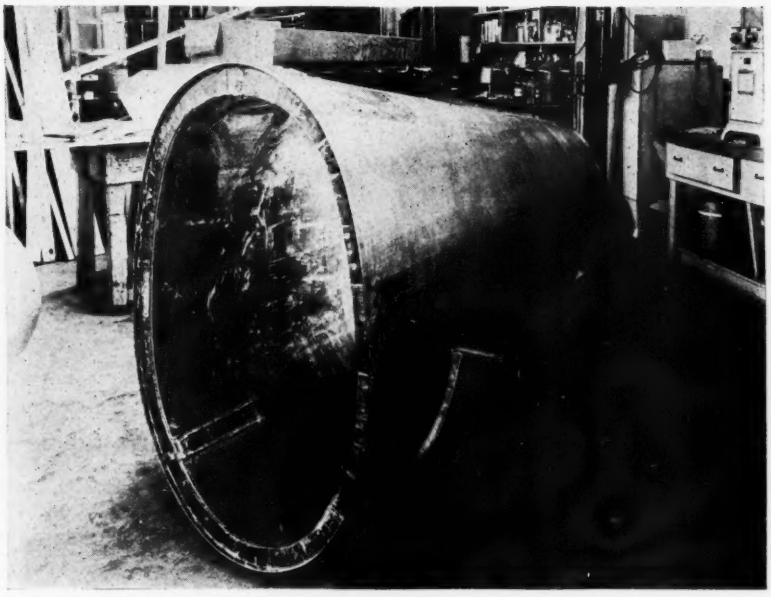


Fig. 3. Honeycomb fuselage.

The all-glass fuselage represented a substantial advance over the initial glass balsa combination. Load distribution in the two types of sandwiches used in the fuselages differed considerably. In the glass balsa sandwich the balsa core carried approximately 40 per cent of the total load, since the grain was placed parallel to the glass cloth faces, while in the glass honeycomb sandwich the entire load was carried in the faces alone. Integrally molded glass fiber fittings used in the honeycomb sandwich fuselage proved that an efficient all-glass fitting could be designed to take out concentrated loads. To demonstrate conclusively the possibilities of this new material, the Air Technical Service Command is currently undertaking the development of an all-glass wing.

The development of glass laminates is still in its infancy. In the short period of 3 years, research has resulted in the increase of the physical properties as much as 100 per cent. Even at present, only a small percentage of the strength of glass fibers is being developed, and it can be reasonably anticipated that further research will result in substantially higher strengths. The present typical strength of the continuous type D glass fiber is approximately 300,000 lbs. per sq.in. while the strengths of experimental fibers have gone well beyond 1,000,000.

Table 3. Static Test Results

Strength-Weight Comparison of Glass Sandwich Fuselages to Standard Fuselages BT-13 BT-15 Airplane

Type of Structure	Weight, Lbs.	Destruction Test Load,* Per Cent Ultimate	Strength-Weight Ratio, Per Cent
Aluminum alloy semimonocoque	70	108	100
Wood semimonocoque	86	110	82
Glass cloth-balsa sandwich monocoque	78	180	150
Glass cloth-honeycomb sandwich monocoque	75	180	155

* Tail-wheel side load condition.

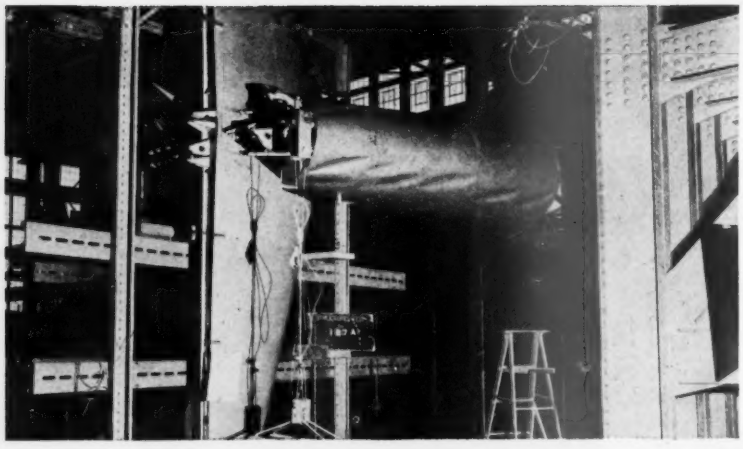


Fig. 4. Metal fuselage test.

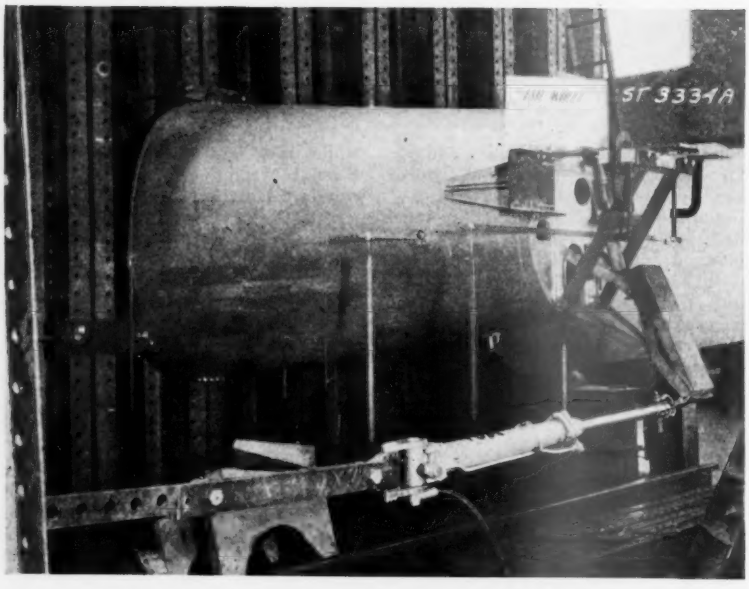


Fig. 5. Sandwich fuselage test.

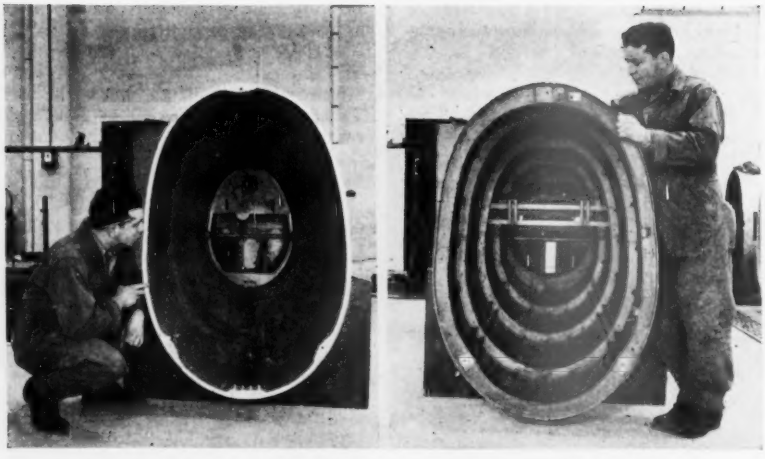


Fig. 6 (*left*). Sandwich interior. Fig. 7 (*right*). Metal interior.

Design Simplicity

The simplicity of design inherent in this type of structure because of elimination of complicated internal stiffening elements and their attachments is apparent in Figs. 6 and 7. The number of parts and, consequently, the number of man-hours necessary in aircraft manufacture and maintenance is automatically reduced. The analysis of the structure is simplified, and the number of drawings required for its fabrication is greatly reduced. The necessary tooling can also be substantially simplified and the quantity of jigs minimized, since the low-pressure molding technique lends itself to the fabrication of complete units, such as the wings or fuselage, in one operation. Since the molds are essentially outside contours of the aircraft components, major structural changes within the mold line can be incorporated without changing the molds.

If redesign necessitates changing the outer contour, new molds can be fabricated simply and economically. It is apparent that this results in a flexible production setup.

Maintenance

Repairing of glass cloth sandwich structures will differ fundamentally in that the repairs could be made without altering the integrity of the structure. A glass patch can be applied in a manner similar to that employed in vulcanizing a patch on a tire. A piece of impregnated cloth is smoothed on the damaged area and cured by an infrared lamp or sunlight.

Other Advantages

Operational advantages include greater aerodynamic efficiency because of the elimination of rivets and joints and the greater rigidity of the structure. Airplanes will be quieter and warmer because of the superior thermal and acoustical properties of the material itself. Additional soundproofing is unnecessary. Color can be incorporated into the laminating resin providing a durable, permanent, and washable interior and exterior finish.

Structural applications using these new materials have been handicapped by the necessity of designing for attachment to existing aircraft. The use of conventional metal fittings results in inefficient load transfer into the laminated glass structure. Ultimate goal of this development is an all-glass airplane using the design best adapted to the material.

Because of the electrical characteristics of the glass cloth laminates, extensive application of this material has already been made for radar housings. When extended, these radomes reduce the cruising speed of our bombers by as much as 5 m.p.h. Therefore, the solution to efficient radar installation would also be to make the airplane structure of laminated glass. The possibilities of this material in radar-directed, pilot-

(*Continued on page 82*)

Fatigue Failures of Aircraft Parts—Their Cause and Cure

DANIEL M. DAVIS*

Consolidated Vultee Aircraft Corporation

Introduction

THE PURPOSE OF THIS PAPER is to attempt to reduce the phenomenon of fatigue failures of airplane parts to a reasonable and understandable system of logic and to review some experiences with actual parts that have failed in service from repeated loading. There have been perhaps thousands of articles, reports, and books written on fatigue of metals.[1] Unfortunately, an overwhelmingly large percentage of this material is usually of purely academic interest, having no *direct* practical application. However, if we glean from each published work on fatigue one item of a significant, practical value and correlate it to our present problem, we will soon have a foundation upon which to establish criteria for designing against fatigue failures.

Basically, a fatigue failure is the result of the existence of one or more of the following factors: stress concentrations, deflections, and vibration. The effects of these will be discussed in this report.

This paper is divided into two sections:

(1) Historical data and a summary of general fatigue failure data as they pertain to our present problem.

(2) Examples of experience with fatigue failures of parts on airplanes in service. This will be limited to primary structure parts, and further limited to parts on which test data are available.

Reference to other works and reports shows that most airplanes seem to have similar characteristics of repeated loading, regardless of the type of airplane. This points out the need for a great deal more data than are presently available. It is quite conceivable that more efficient aircraft structures will be the result when criteria for repeated loading become part of the design information for an airplane. Any dangers that may be anticipated can then be eliminated by careful design without any unnecessary increase of weight.

The Phenomenon of Fatigue

The phenomenon of fatigue failures, as failure from repeated loading is most commonly known, was first recognized around 1849[2] when it was discovered that cast-iron bars loaded repeatedly to about one-third of the ultimate strength would break after about 100,000 applications of load. Since that time a tremendous amount of research work has been done in an effort to evaluate all the variables affecting the fatigue strength or endurance of practically every known material. Attempts have also been made to correlate fatigue strength as a function of design. So far, these latter results are qualitative only. Quantitative results can be obtained only by fatigue testing each individual design.

Fatigue failures have been logically explained as being caused by slippage of the individual crystals of a piece of metal when under load.[3] When the stresses are low, only a few crystals are disarranged each time the load is applied. If the load is applied a great many times, the crystals in the entire section eventually become disarranged and sufficient slippage occurs along the crystal faces to cause a crack to appear. The number of crystals disarranged with each loading, and therefore the number of loadings, is a function of the magnitude of the load. Although this theory is logical and can be proved by micrometallurgy, there is as yet no means available, except actual testing by repeated loading, to determine the endurance of any given part. The best we can do is to make a prediction based on experience.

In spite of the unknown factors connected with fatigue failures, it can be shown that all materials and parts show the existence of a clearly defined law governing the action of a part under repeated loadings. That there is a definite mathematical law was pointed out by Prof. H. O. Basquin, who published in 1910 his discovery which he called "the exponential law of endurance tests."[4] This he demonstrated in the following manner:

Fig. 1 shows an S-N curve plotted on ordinary rectangular coordinates. The left portion of the curve is extremely difficult to read accurately. To overcome this difficulty the type of curve shown in Fig. 2 has become the standard type of S-N curve for most work of this type.

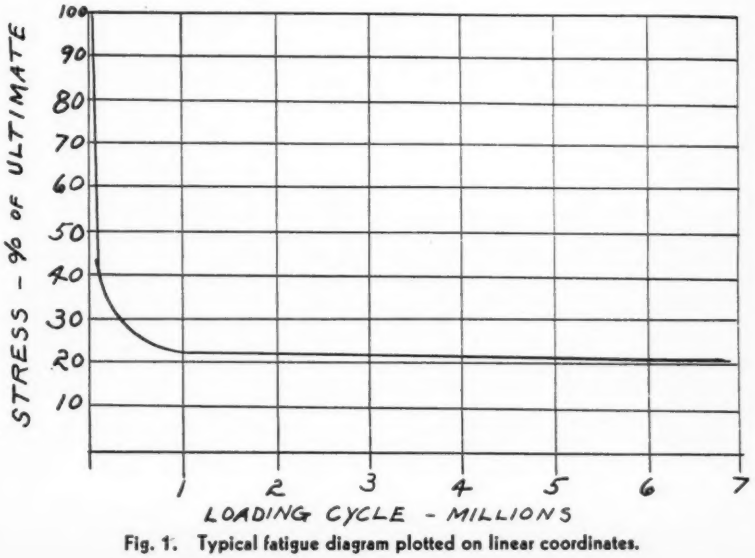


Fig. 1. Typical fatigue diagram plotted on linear coordinates.

Received December 4, 1944. To have been presented at the I.A.S. Thirteenth Annual Meeting, which was canceled to cooperate with a Government appeal (January, 1945) to refrain from holding conventions and meetings.

* Weights and Structures Supervisor, Vultee Field Division.

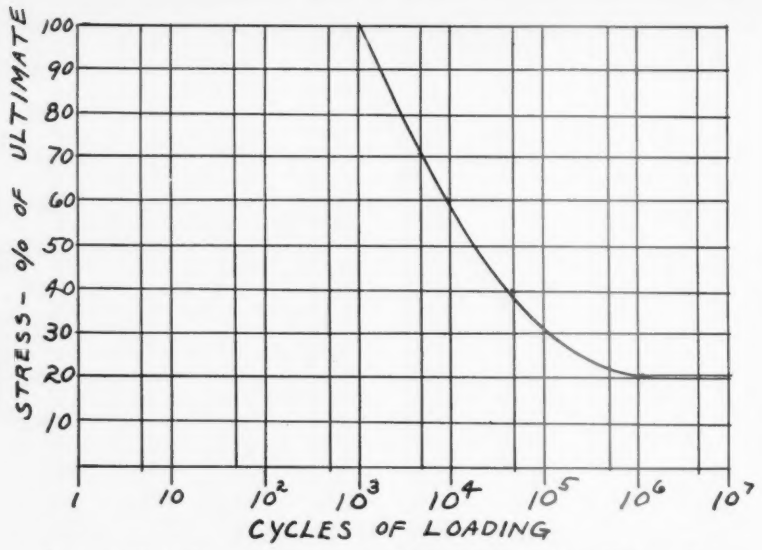


Fig. 2. Typical fatigue diagram plotted on linear ordinates and logarithmic abscissa.

Here the number of cycles is plotted logarithmically while the stress is plotted linearly. Professor Basquin plotted the S-N curve on log-log-coordinates which results in a curve shown in Fig. 3. This curve can be represented by the equation:

$S = CN^n$

N = number of repetitions of the stress S to produce rupture

C = a stress coefficient, or the stress needed to break the specimen under static loading

n = an exponent found from the S-N curve by measuring the angle which the curve makes with the horizontal, or abscissa, and finding its tangent

Further on in this report we will show how the curve of Fig. 3 and its equation become of significance in the design of aircraft parts.

Causes of Fatigue Failures

The major factors that cause a shortening of the life of any part subjected to repeated loading are basically the result of the existence of one or more of the following items:

(1) Stress concentrations.
(2) Deflections.
(3) Vibration.

The line of demarcation between any of the above items is often difficult to determine. For instance, vibration can be considered a large number of deflections occurring within a relatively short time.

The effects of stress concentrations will not be discussed here in any detail since there is a considerable amount of literature available on the effects of various types of stress concentrations. In general, the effects of a great many typical stress concentrations have been evaluated in terms of three different parameters as follows:

(1) The endurance limit is established for a "par" bar or part that does not have the stress concentration. A part with the stress concentration is then tested at the same load as the "par" part. The difference in life then becomes a measure of the stress concentration.

(2) The tests are conducted as described in the preceding paragraph except that the load is reduced to maintain the same life for the part with the stress concentration as was originally obtained with the "par" part. In this case, the ratio of the loads becomes the measure of the stress concentration.

(3) The stress concentration is actually measured, either by means of photoelastic tests with a suitable plastic model or by exploring the actual part under load with suitable strain gages to determine the actual stresses imposed.

The last-mentioned means for determining the value of stress concentration yields valuable information on the nature of the *design*. Quite often stress concentrations appear in unexpected places and for unexpected reasons, as for instance at the point of application of the load. These errors in design can be discovered and corrected with the expenditure of a great deal less time and money than by finding them the hard way—by failure of parts in service.

However, this does not necessarily give a true evaluation of the life of the part in service as it does not take into consideration the factors causing reduced life which are not a function of design. These include internal stresses due to heat-treating or welding, or the notch effects of surface conditions because of machining. These can be evaluated best by the method described in item 1 above. We can establish a "par" for the part by determining the amount of load and the number of applications of load the part should withstand to ensure a satisfactory life of the part as it is installed in the airplane. This would be included in the criteria to be established for the design of the particular type of part.

The effect of deflections can be shown in two typical forms. Let us first consider a part such as an antenna mast or pitot tube mast. Let us assume, merely for the simplicity of calculation, that the elastic curve of deflection of the mast is similar to that of a cantilever beam uniformly loaded. The maximum deflection is then given by the equation

$$d = ML^2/4EI$$

where

M = maximum bending moment at the fixed end of the beam
L = length of beam
E = modulus of elasticity
I = moment of inertia (assumed constant for this illustration)

The maximum stress is represented as

$$f = My/I$$

or

$$M = fI/y$$

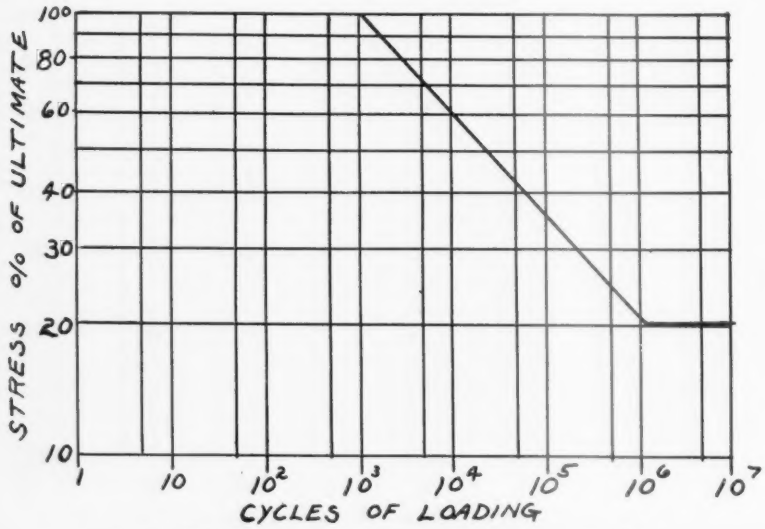


Fig. 3. Typical fatigue diagram plotted on logarithmic coordinates.

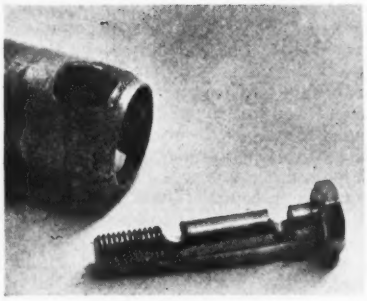


Fig. 4. Effect of vibration on part with oversize bolt hole.

y = distance from neutral axis to extreme fiber.

Substituting:

$$d = fIL^2/4EIy = fL^2/4Ey$$

stress due to deflection is then:

$$f = 4Eyd/L^2$$

Let us assume that a tube $1^1/_2$ in. outside diameter, 30 in. long, picks up a resonant vibration of 1,200 cycles per min. with a deflection of $^1/_2$ in. each side of neutral. The stress then would be 17,200 lbs. per sq.in. The clamping action at the attachment produces a serious stress concentration, so that the endurance limit under these conditions is 5,000,000 cycles. Experience has shown us that this is a reasonable figure. At 1,200 cycles per min. this represents less than 70 hours of life. Just how long it would take to accumulate 70 hours of vibration is a matter of conjecture. If this type of vibration were present for only 5 min. during each hour of flight, the part would last for only 840 hours of flying time. The thing to remember is that the effects of fatigue loading are cumulative. "Rest" periods between periods of loading do not increase the number of applications of load a part is able to endure. Thus, even short periods of vibration can easily build up a large number of applications of load on a part.

Another type of deflection that is quite often neglected but which can become very dangerous as we shall show later, is that which occurs on sheet-metal components, particularly at free edges. A sheet-metal part subjected to compression load may buckle slightly. This usually does not impair the load-carrying capacity of the part as a whole. However, at the buckle the stress starts out as compression; then, as the height of the buckle increases, the stress on the outside reverses itself to tension because of the local bending of the sheet. When this stress reversal occurs at an edge, which may have many tiny nicks and notches (the severest type of stress concentrations), an extremely low endurance results for parts subjected to repeated loading.

The effect of vibration also can be shown by the fact that in order to have the part speed up, slow down, stop, and then speed up again many times a minute, as occurs when vibration is present, great accelerations can be imposed. The equation for the acceleration in g's in terms of deflection and frequency is:

g = $.0000284dN^2$
d = deflection each side of neutral
N = frequency in cycles per min.

Thus, when N is large, even exceedingly small deflections can build up high loads. For example, suppose a part is subjected to a vibration of 2,400 cycles per min. with a $^1/_{16}$-in. deflection (single amplitude). The resulting acceleration is $10g$. Very few parts are at present designed to hold up long under such conditions. Yet this condition exists in the power-plant section of a number of airplanes, particularly in the attachment of accessory components. Witness the extremely large number of failures of power-plant and nacelle components that are continually occurring.

An example of the effect of vibration is shown in Fig. 4. The part is a hand-crank extension for an engine starter.

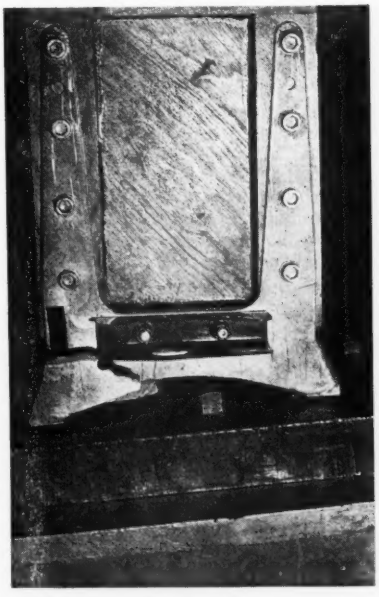


Fig. 5. Wing fitting failure after approximately 200 applications of applied load.

The only load ever imposed on this part was from its own weight, which is approximately $1^1/_2$ lbs. The bolt is $^1/_4$ in. in diameter, but through an error the hole in the part was drilled $^1/_{16}$ in. oversize. The results shown are after approximately 100 hours of engine operation. Although this is an extreme case of the effects of vibration, it serves well to illustrate the point.

Criteria for Fatigue Loading

One of the serious drawbacks to designing for the elimination of fatigue failure is the lack of established standards as to the stress range and the number of cycles of loading a part should withstand. Obviously, to require an infinite life for maximum loading could penalize the airplane from a weight standpoint. The line has to be drawn somewhere based on the expected frequency of loading and the expected life of the airplane. Some work of this nature has been done for automobile parts and is apparently highly successful.[5]

A considerable amount of fatigue testing has been done on a number of aircraft parts at the Consolidated Vultee Aircraft Corporation, Vultee Field Division.[6] Some preliminary criteria have been established based on the actual fatigue tests of the parts involved compared to the life at the time of failure in service. A number of typical examples will be discussed in this paper. Since no actual flight loading data were available, the magnitude of the loading for these fatigue tests was arbitrarily considered to be at or near the maximum applied load in order to be conservative in the estimate of the stress range. Parts were then tested by repeated loadings to a load of the aforementioned magnitude until a failure that duplicated the failure in service was produced. The number of loadings required to produce failure was then correlated with the life of the part in service on the airplane. Further tests made on an improved design of the part involved were then compared with the tests on the original part.

Although the above procedure gave some interesting and useful results, the method for determining the required life of a part is at best makeshift, the criteria for the life of a part being established only after the part has failed in service. This is obviously an unsatisfactory method for establishing the criteria but it is the only one available at the present time.

It is interesting to note that all airplanes tend to yield the same results as far as repeated loading is concerned. Correlating, for instance, one test on a trainer landing-gear part with a landing test on a medium bomber[7] and a landing test on a large transport,[8] the coincidence of the three values of load and frequency of application is remarkable. This may indicate that a research program may not be so extensive as one might think. If the results of tests on one type of airplane can be used for the designing of an entirely different type airplane, the cost of such a program will of course be considerably lessened.

The need for such results is further indicated by the tendency to design airplanes to lower load factors in an effort to cut down structural weight. For instance, for a transport airplane designed to an ultimate load factor of 6 with repeated loadings averaging $1^1/_2$ factors (one-half factor above normal level

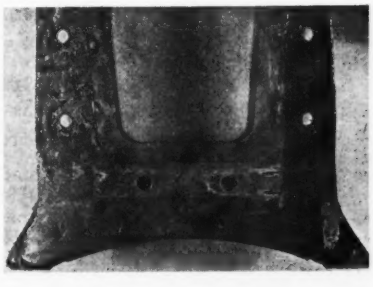


Fig. 6. Wing fitting with added reinforcement.

Fig. 7. Service failure of wing fitting.

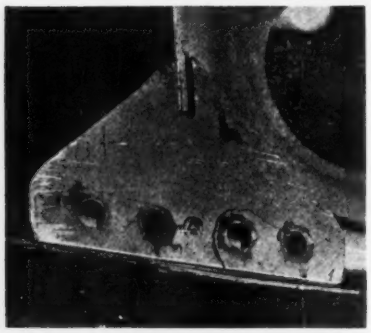


Fig. 8. Fatigue failure of fitting on metal wing.

Fig. 9. Redesigned fitting for wood wing after 11,650 applications of applied load.

flight for various reasons such as maneuvers and gusts), the maximum stress of these repeated loadings is approximately 25 per cent of the ultimate; whereas for a transport airplane designed to an ultimate factor of $4^1/_2$ and subjected to the same repeated loadings of $1^1/_2$ factors, the maximum stress of these repeated loadings is then 33 per cent of the ultimate. This increase in percentages may remove all possible margins of safety on any parts with any degree of stress concentration. With large transports, designing to even less than an ultimate factor of $4^1/_2$ is possible.[9]

A study of gust loads occurring over a considerable area, both in this country and in Europe,[10, 11] indicates that the frequency is relatively high for gusts of low velocity. The large gust of which everyone is aware occurs somewhat infrequently. Thus we have the possibility of a large number of applications of a relatively small load which, as we can prove, is often more dangerous than a single application of an extremely large load.

Another source of high-frequency repeated loading occurs in buffeting of the empennage surfaces. There has been some work done on this but considerably more information is required before this phenomenon can be accurately dealt with during the design stages of the airplane. Here again, tests show that a close similarity of results exists among airplanes of widely diversified types.

With the advent of rotary wing aircraft, a new set of problems will be presented for the designer to solve. In the rotors there are torsional and bending vibrations and fluctuations of load from the advancing to the retreating portions of the blade cycle. All these are accompanied by large stresses due to centrifugal forces. Then, of course, there are fluctuating loads on the driving and controlling mechanisms. In addition, there is the disagreeable problem of resonance and interaction between parts.

Results of Tests

Wing Components

One of the most interesting series of fatigue tests was made on a steel outer wing attachment fitting of a basic trainer. This part had been static-tested as part of the routine static tests of a wood outer wing panel. The short fatigue life of this particular part was accidentally discovered when it was decided to subject the wing to a combination of weathering and repeated loading tests in order to test the strength of the wood components of the structure. The fitting itself failed in this test after 131 applications of 67 per cent of design load, which corresponds to full applied load. Other fittings were tested, all of which failed at between 175 to 200 applications of load. A typical failure is shown in Fig. 5. This was considered to be extremely serious and the part was immediately strengthened. The strengthened part is shown in Fig. 6. This redesigned part then carried an average of about 2,500 to 3,500 applications of load, which was considered to be sufficient improvement over the original design.

Along about that time reports were received from the field indicating failures of this part in service. Of the parts that failed, the average time was from 150 to approximately 500 hours of flight, the average being slightly over 300 hours. Fig. 7 shows a part that failed in service. It is easy to see that this failure is identical with the failures obtained in the laboratory.

In the meantime, an aluminum-alloy fitting of a different design for the same airplane was also tested. This had previously been fatigue-tested in conjunction with a test of a magnesium skin outer wing panel. This part withstood 7,279 applications of applied load without failure when the test was discontinued for other reasons (see Fig. 8). Another fitting was tested and withstood 4,763 applications of load before failure. This fitting had several bolt

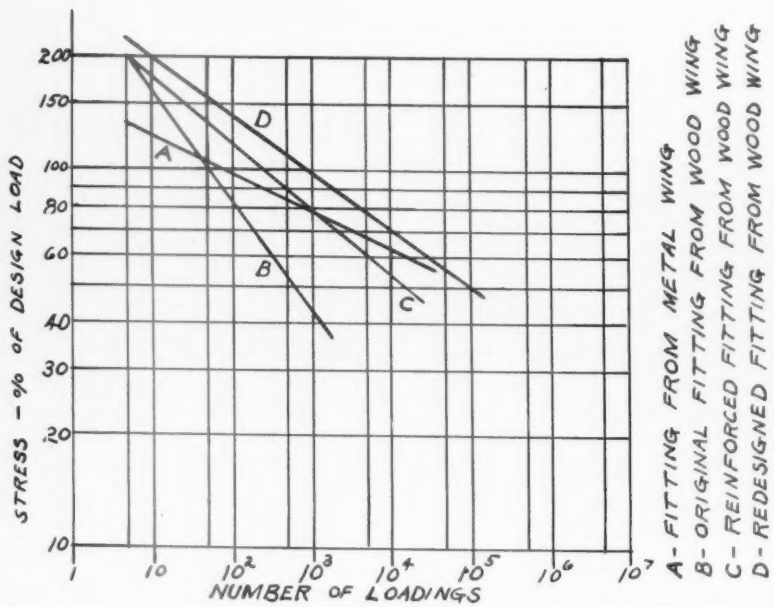


Fig. 10. S-N curves of wing fittings showing effect of design on slope of curve and relative efficiency of designs.

failures occur before the fitting itself failed, which is probably the reason for the difference between this and the first fitting of this type. These fittings have given no trouble in service.

It was decided that, although the rework of the first-mentioned steel fitting was a great improvement over the original, an investigation should be made of a possible redesign. The redesign is shown in Fig. 9 after it had carried 11,650 applications of applied load before failure. A fitting of this type would be expected to outlast the airplane by a considerable amount.

Static tests of the steel fitting had been made but no part was ever broken under static loading. Even with heat-treated bolts the fitting was stronger than the bolts. From the results of static test it is safe to assume that this fitting could probably carry 200 per cent of design load. The dural fittings would carry approximately 125 to 150 per cent of design load.

Referring to charts similar to that of Fig. 3, we can show how the slope of the S-N curve is affected by stress concentration. By taking the results of one of the aluminum-alloy fittings and plotting that on the chart shown in Fig. 10, and taking the results of the steel fitting and plotting in on the same chart, one can easily see the effect of stress concentration. In addition, the slope of these curves can be of significance in terms of weight of the parts. A part that will carry 200 per cent design load is likely to be heavier than a part that will carry 125 per cent design load. It can thus be shown that a careful consideration of the fatigue strength of the part may have as much effect on its weight as static strength.

Fig. 11 shows a photoelastic model subjected to test giving an indication of the stress concentration occurring at the point where the fittings were failing.

Another sidelight on this series of tests was the failure of the plastic model through an accidental overloading. This failure was identical with the failure of the steel parts. Here again we see evidence of an exact natural law acting on these parts. The failure had to occur in this manner because the material was following Nature's orders.[12] This is shown in Fig. 12.

Fig. 11. Photoelastic pattern of plastic model of wing fitting showing the points of stress concentration at the lower edge and at one of the bolt holes.

By correlating the results of these tests with failures that occurred in service, it was established that a loading of this particular part of this particular type of airplane is equivalent to approximately one applied load per hour of flight.

In connection with some of the failures of the outer wing fitting, it was found that a number of bolt failures had also occurred. This is believed to be partially attributable to improper tightening of the attachment bolts. It can be easily shown by tests that a properly tightened bolt will not fail from repeated loading. For instance, if a bolt is to carry a load of 10,000 lbs. and is tightened so that a preload of 10,000 lbs. occurs, the stress range will be zero for repeated loadings of 10,000 lbs. since the load in the bolt will not change at all. However, if this bolt has no initial tension, the load will vary from zero to 10,000 lbs. for each application of load and this will in time cause a fatigue failure. So far, the only method used for an accurate determination of prestressing of bolts is torque wrenches. This method is far from satisfactory, as pointed out by J. O. Almen, of General Motors Research Laboratory.[13]

Some of the variables, such as the presence or absence of lubricants, surface conditions, plating, etc., can easily cause a ten to one variation in preload for a given torque loading. Even after a bolt has been properly tightened, a slackening of 0.001 in. in a grip length of $^1/_2$ in. for any reason will cause a loss of 50,000 lbs. per sq.in. in the preload stress. Thus it can be seen that the problem of obtaining a proper preload is an extremely difficult one to solve. Mr. Almen suggests that some precision means of measuring the stretch of the bolts, such as micrometers or extensometers, be used. This is often somewhat impracticable.

A wing-to-fuselage attachment fitting began failing in service after approximately 2,000 hours of flight. The failures seemed to indicate that a repeated side load was being applied to these fittings. In the design of these fittings it was assumed that no side load could be carried through them. However, it was discovered that one item was neglected as a source of load. This was due to the shortening under compression load of the spar cap to which these fittings were attached. These fittings are approximately $17^1/_2$ in. from the centerline of the airplane. The compression stress at the spar at design load was 35,400 lbs. per sq.in. Taking a load of 60 per cent design load and $17^1/_2$ in. in length, the elastic compression of this spar cap is 0.036 in.

Since

$$e = \frac{fL}{E} = \frac{(0.60)(35{,}400)(17.5)}{10{,}300{,}000} = 0.036 \text{ in.}$$

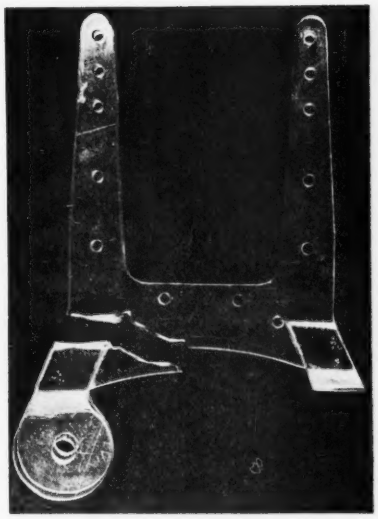


Fig. 12. Failure of plastic model of wing fitting showing the similarity to the failure of the steel fitting.

These fittings were tested under repeated load that would produce a deflection of 0.036 in. This required approximately 40,000 reversals of load to duplicate the failure in service. The failure occurred either at the edge of the washer that caused stress concentration or at the base of the fitting which again is a point of stress concentration because of the change of direction of material. Various combinations of thicknesses and diameter of washers were tried, none of which seemed to give sufficient improvement over the original design. It was then decided to use a thinner material that would involve less stress for a given deflection as was shown previously, since the stress for a given deflection is proportional to the thickness of the material, or the y distance to the extreme fiber. It was also necessary to change the material to steel to provide sufficient strength. Although this would raise slightly the stress due to bending of the fitting itself, because of a higher value of modulus of elasticity, the fatigue limit of the material was considerably higher. This fitting and the results of the tests are shown in Figs. 13 and 14. The number of loadings the new part could withstand was raised to 100,000 to 160,000 applications.

It is to be noted that a plate was added to act as stiffener for the bottom to keep it from bending when subjected to tension loads. This seemed to have no effect on the fatigue strength.

The number of applications of loading in service in this case appeared to be equivalent to 20 reversals per hour of flight.

Empennage Components

One of the great sources of trouble encountered in all types of aircraft occurs in the empennage and empennage fittings. On one model, failures began occurring after about 2,000 hours of flight. The vertical stabilizer rear spar attachment to the fuselage would crack,

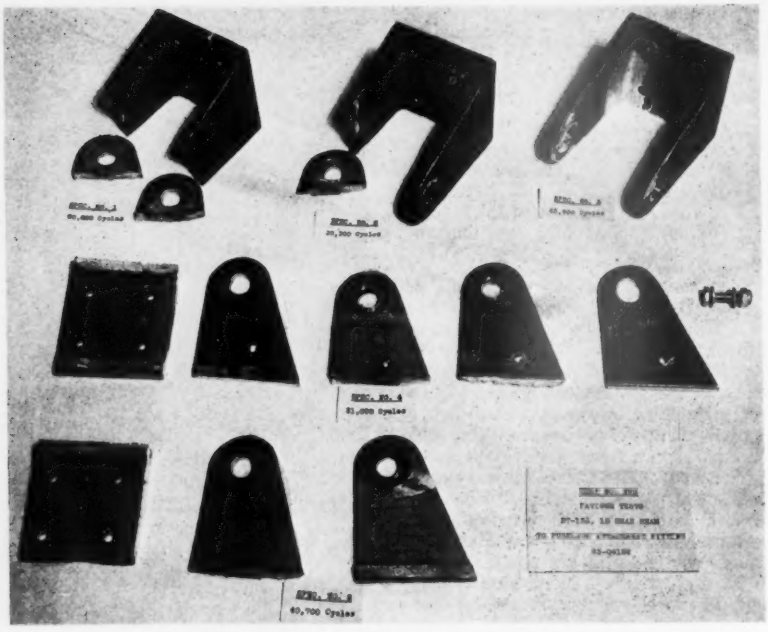


Fig. 13. Test results of original wing-to-fuselage attaching fitting.

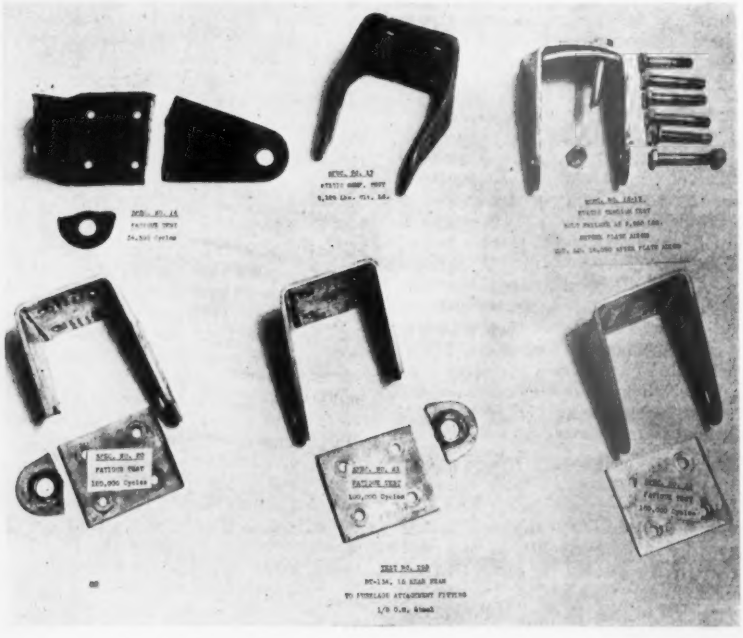


Fig. 14. Test results of redesigned wing-to-fuselage attaching fitting.

starting at a free edge of 0.051 aluminum alloy and would progress rapidly until complete failure occurred. This failure, if not caught in time, would result in loss of the airplane. Tests were made which duplicated the failure in service. Fig. 15 shows failure of the part after approximately 2,000 reversals of applied load. The failure was identical with that which occurred in service. This is equivalent to one load application per hour of flight. The stresses involved were relatively small, but it was noticed that the sheet would buckle at the edge between the bolts at the point where the failure occurred. This caused a bending back and forth of the material, giving extremely high reversals of stress due to the local buckling (see Fig. 17). In addition, tool marks and other nicks and scratches provided stress concentrations that accelerated the start of the failure. The defect was remedied by adding flanges to stiffen the edge, as shown in Fig. 16. On another version of this stabilizer, the fitting was made of 0.072 aluminum-alloy sheet instead of 0.051 sheet. At applied load there was no buckling at the edge of the sheet. This part was tested and successfully withstood 20,000 reversals of applied load, and was therefore considered satisfactory.

Failures similar to those of the vertical stabilizer occurred on the horizontal stabilizer. Here again the cause seemed to be a local buckling of an edge of a sheet-metal bracket. Failure would start at the edge because of the high stress reversals and, once failure started, the progress of the rupture was extremely rapid. Fig. 18 shows a part that had failed in service after about 2,000 hours of flight. An attempt was made to test the horizontal stabilizer by repeated loading at applied load. After 20,000 reversals of applied load, no failure occurred. To apply more than 20,000 reversals of applied load seemed unreasonable. It was then decided to vibrate the surfaces in order to obtain a large number of reversals at lower load. Tip deflection during vibration was approximately $^{3}/_{8}$ in. each side of neutral. This corresponds to approximately 30 per cent of design load. After approximately 1,000,000 reversals, failure occurred which simulated the failure in service.

In this particular case it was practically impossible to reinforce the fitting and maintain interchangeability. It was therefore decided that the best cure would be to change the aluminum-alloy fitting to an identical fitting of normalized chrome-molybdenum steel. The reason behind this change was that the higher modulus of elasticity would tend to delay the buckle at the edge of the material. In addition, the higher endurance allowables of steel would tend to increase the life of the part. A test of stabilizers with steel fittings installed indicated that the life of the part was doubled.

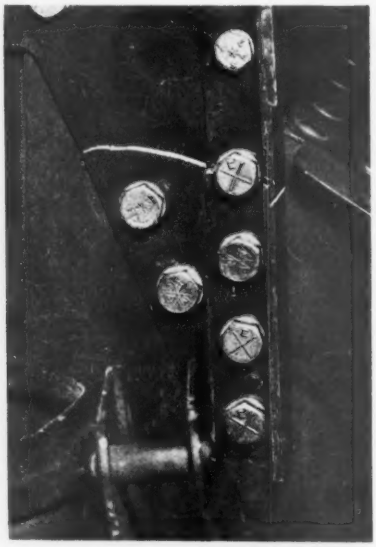


Fig. 15. Failure of vertical stabilizer attaching fitting, identical to service failure, after 2,000 reversals of applied load.

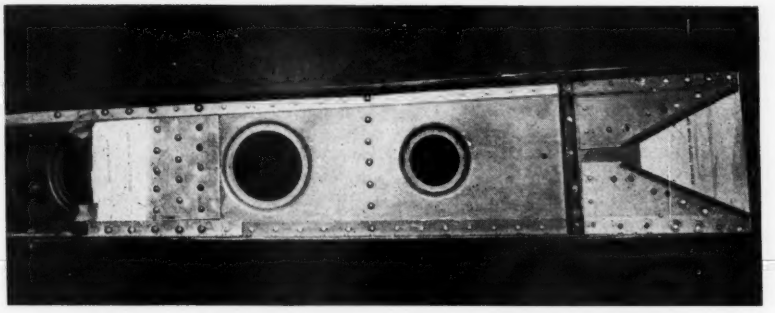


Fig. 16. Vertical stabilizer attaching fitting with flanges added. No failure occurred after 20,000 reversals of applied load.

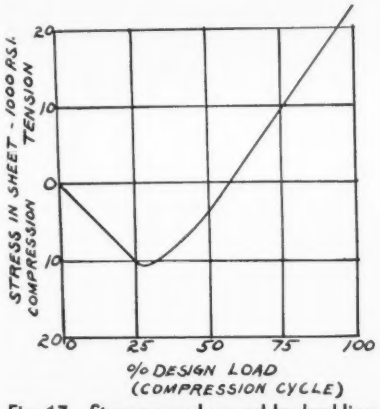


Fig. 17. Stress reversal caused by buckling of sheet in compression.

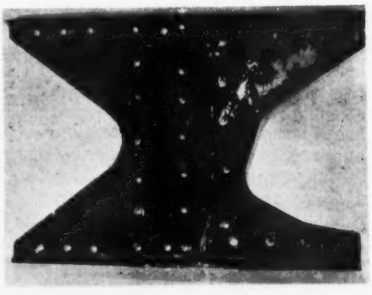


Fig. 18. Horizontal stabilizer attaching fitting failure after approximately 2,000 hours of flight. Note buckle at edge of sheet near fracture.

An interesting substantiation of the fact that empennage parts are subjected to high-frequency applications of loads was shown in the work done on a dive bomber. Fig. 19 shows an elevator hinge bracket that failed after a short time in service. After considerable testing this bracket was redesigned as a steel part with additional bolts for increased strength. An actual record of the stresses occurring in flight was made by the use of dynamic strain gage recording equipment. Results are shown in Fig. 20 which gives the stresses imposed on this hinge bracket during a 4*g* pull-out at 300 m.p.h. The major portion of the loads shown is caused by a sideways vibration of the elevator and is a secondary source of stress rather than being caused by the direct application of load on the elevator. Stress reversals shown are approximately ±25,000 lbs. per sq.in. or a stress range of 50,000 lbs. per sq.in. This is high even for steel for any part that is expected to last a long time. The frequency of these stress reversals reaches as high as 6,000 per min. in various spots along the path of the indication in Fig. 20. Thus, although the actual maneuver in this particular case took only 4 sec., the number of reversals of load is somewhere in the neighborhood of 300. In cases like this, it is probably better to direct the design effort toward the elimination of such large numbers of load reversals rather than to strengthen the parts to withstand them.

Further interesting data taken on the same dive bomber are shown in Fig. 21. This gives additional information as to the stresses occurring at various parts of the empennage. It can be seen that, instead of a single application of load occurring during a maneuver, there are a large number of stress reversals which, although they may not be of a high magnitude, are a serious problem because of their high frequency. Here again it may be well to concentrate on some type of damping means to eliminate the source of these vibrations rather than to penalize the structure with a weight of fittings sufficiently strong to ensure a high endurance.

Fig. 19. Outboard elevator hinge bracket failure after a few hours of flight.

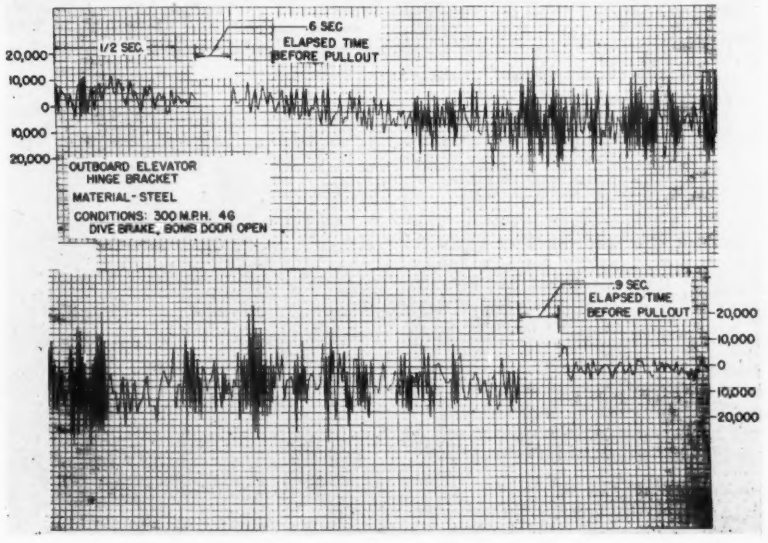


Fig. 20. Dynamic strain gage readings on redesigned outboard elevator hinge bracket during a 4*g* pull-out at 300 m.p.h.

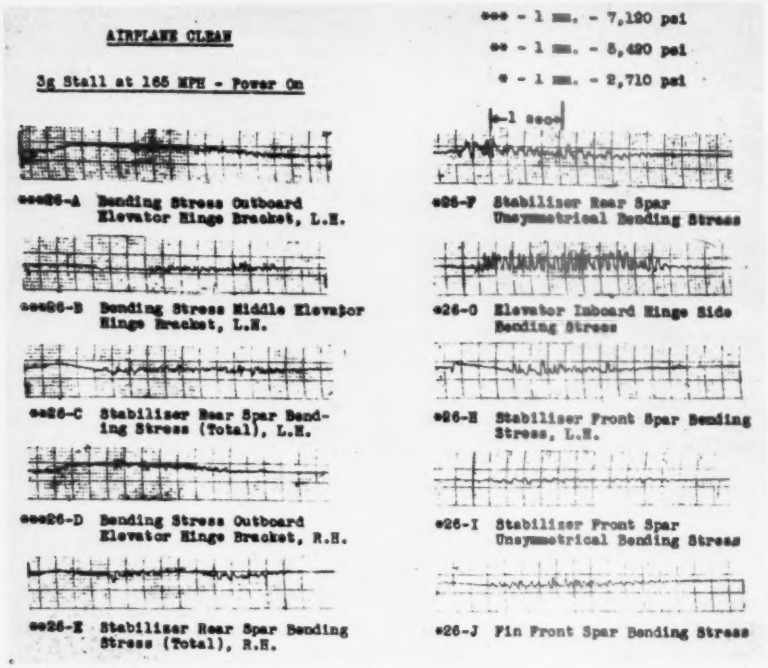

AIRPLANE CLEAN
3g Stall at 165 MPH - Power On
*** - 1 mm. - 7,120 psi
** - 1 mm. - 5,420 psi
* - 1 mm. - 2,710 psi
1 sec
***26-A Bending Stress Outboard Elevator Hinge Bracket, L.H.
***26-B Bending Stress Middle Elevator Hinge Bracket, L.H.
***26-C Stabilizer Rear Spar Bending Stress (Total), L.H.
***26-D Bending Stress Outboard Elevator Hinge Bracket, R.H.
***26-E Stabilizer Rear Spar Bending Stress (Total), R.H.
*26-F Stabilizer Rear Spar Unsymmetrical Bending Stress
*26-G Elevator Inboard Hinge Side Bending Stress
*26-H Stabilizer Front Spar Bending Stress, L.H.
*26-I Stabilizer Front Spar Unsymmetrical Bending Stress
*26-J Fin Front Spar Bending Stress

Fig. 21. Dynamic strain gage readings on various empennage elements during a 3g pull-out at 165 m.p.h.

Figs. 22 and 23 are of parts from a trainer showing the effect of vibration on sheet-metal parts. Fig. 22 is a sheet-metal rudder support that developed cracks as shown after approximately 1,500 to 2,000 hours of flight. These parts have been reinforced or replaced by castings. Fig. 23 is the elevator bell-crank support that failed as shown after approximately 2,000 hours of flight. An identical failure occurred when an elevator and stabilizer assembly was vibrated on the vibration table with over 7,000,000 cycles of vibration at $^1/_{16}$-in. double vertical amplitude at 2,400 cycles per min. Had the part been designed with the flanges closer together at the hinge point and a reinforcing plate added, these failures probably would not have occurred.

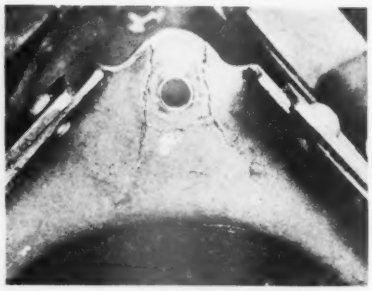


Fig. 22. Vibration fatigue failure of a rudder support after approximately 2,000 hours of flight.

Control System

A frequent cause of trouble in the control system is the type of failure occurring on pulley brackets shown in Fig. 24. This occurs in practically any type of sheet-metal structure where the load is picked up by bent-up flanges. Although statically these may be satisfactory, the constant reversals of load, in addition to the effect of cable vibration, cause fatigue failures of the type shown. The cure for this is simple—merely the addition of filler strips so that the load is put more directly into the web of the fitting, thus reducing the bending of the flanges.

Landing Gear

Another fitting on the trainer which showed evidence of failures from repeated loadings is the fitting that attached the landing gear to the wing. Cracks were noticed after an average of about 1,000 hours of flying time. These cracks would occur at the lower attachment bolts. If these cracks would travel to the bolt hole, no further damage would be done. If, however, these cracks traveled around the bolt head following the edge of the spot face, it was feared that an accident might result.

Tests were made by repeated loading for both the three-point landing and level landing loading conditions but the failure could not be duplicated within a reasonable number of applications of load. On one set of fittings, 25,835 applications of loading were applied, varying from 67 per cent of design load to 80 per cent of design load. It was decided that possibly a vibrational type of loading might be causing the damage.

The parts were then tested by applying stress reversals of about 90 per cent of applied load in the fore and aft, or drag, direction. A typical failure occurred after about 45,000 applications of loading. It seemed that this failure was caused by a concentration of stresses which was inherent in the design of this particular part. The cure for this was simple—since no further damage ever occurred when the part cracked with the crack leading into the bolt hole, it was decided to add a saw cut in this location which would cause the stresses to be relieved. A part reworked in this manner was then tested and did not fail until after 176,600 reversals of load. Figs. 25 and 26 show the results of this test.

It has been estimated that there are four or five landings made on this type of airplane per hour of flight. This would correspond to approximately ten load reversals of the magnitude of the test per landing based on the test of the original part. There is a remarkable coincidence of this figure with results obtained by actual stress readings made during landing of a medium bomber[7] and a large transport.[8] If further tests should prove this coincidence to be a fact for all aircraft, the task of setting up design requirements would be made easier.

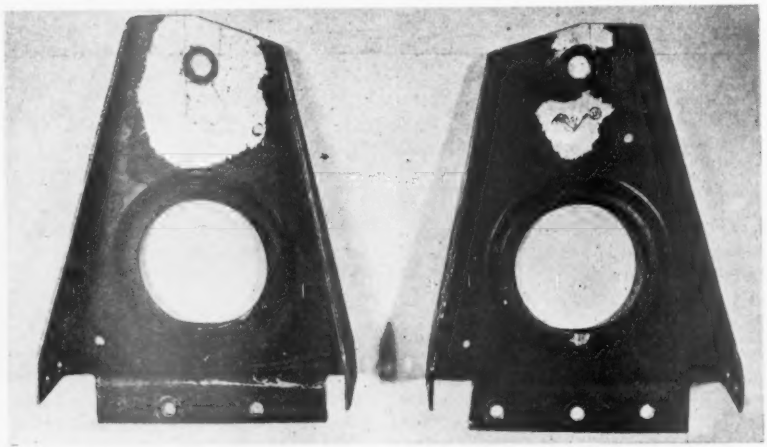


Fig. 23. Elevator bell-crank support after 2,000 hours of flight.

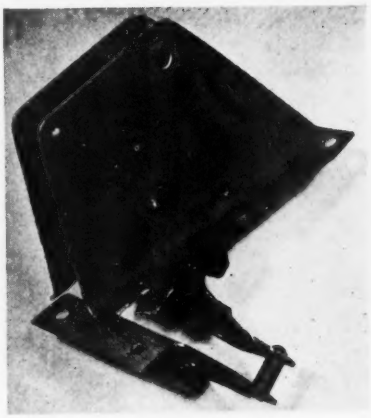


Fig. 24. Fatigue failure of control system pulley bracket.

Fig. 25. Fatigue test results of original landing-gear attaching fitting.

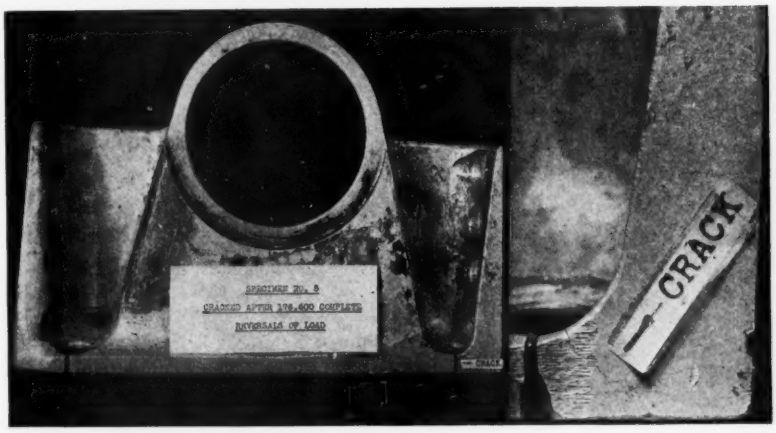


Fig. 26. Fatigue test results of landing-gear attaching fitting after adding saw cut to provide relief for stress concentration.

Miscellaneous

Every aircraft has during its life a large number of miscellaneous fatigue failures on items that are not always structurally important.[14] Such items include engine cowling supports, engine cowling components, miscellaneous equipment supports, fairings, and so on. Although these are usually not dangerous as far as the operation of the aircraft is concerned, it is extremely annoying to the owner of the aircraft to have to continually repair or replace them.

Many of these failures can be avoided by more strict attention to good design. Experience has shown that after a part has failed from fatigue, the rework or the redesigned part that replaces the original part is usually rather elaborate and expensive. The tendency is always to lean over backward to make sure that the failure will not occur again. This causes increased weight and expense that can easily be avoided by proper design of the original part.

Conclusion

It can be said that an increase in efficiency—i.e., reduced weight for a given load-carrying capacity and an increase in the life of aircraft—as flying becomes more universally used as a common means of transportation, is to be expected for future airplanes. This makes the establishment of design criteria for repeated loading of aircraft structural components desirable.

References

[1] Battelle Memorial Institute, *Prevention of the Failure of Metals Under Repeated Stress;* John Wiley & Sons, Inc., New York, 1941. Bibliography, pp. 241–268.

[2] *Encyclopaedia Britannica,* 1943 Edition, Vol. 9, p. 113.

[3] Landau, D., *Fatigue of Metals—Some Facts for the Designing Engineer,* The Nitralloy Corporation, 1942.

[4] Basquin, H. O., *The Exponential Law of Endurance Tests,* Proceedings, American Society for Testing Materials, Vol. 10, pp. 625–630, 1910.

[5] Almen, J. O., *Facts and Fallacies of Stress Determination,* SAE Journal (Transactions), Vol. 50, No. 2, pp. 52–61, February, 1942.

[6] Boyvey, H. O., *Fatigue—The Forgotten Member of the Design Family,* Aero Digest, Vol. 44, No. 1, p. 74, January 1, 1944.

[7] Bergen, W. B., *Experimental Investigations in Aircraft Dynamics,* Journal of the Aeronautical Sciences, Vol. 10, No. 8, pp. 233–249, October, 1943.

[8] Howland, W. L., *Structural Flight Research,* SAE Journal (Transactions), Vol. 52, No. 9, p. 393, September, 1944.

[9] Bland, R. B., and Sandorff, P. E., *The Control of Life Expectancy in Airplane Structures,* Aeronautical Engineering Review, Vol. 2, No. 8, pp. 7–21, August, 1943.

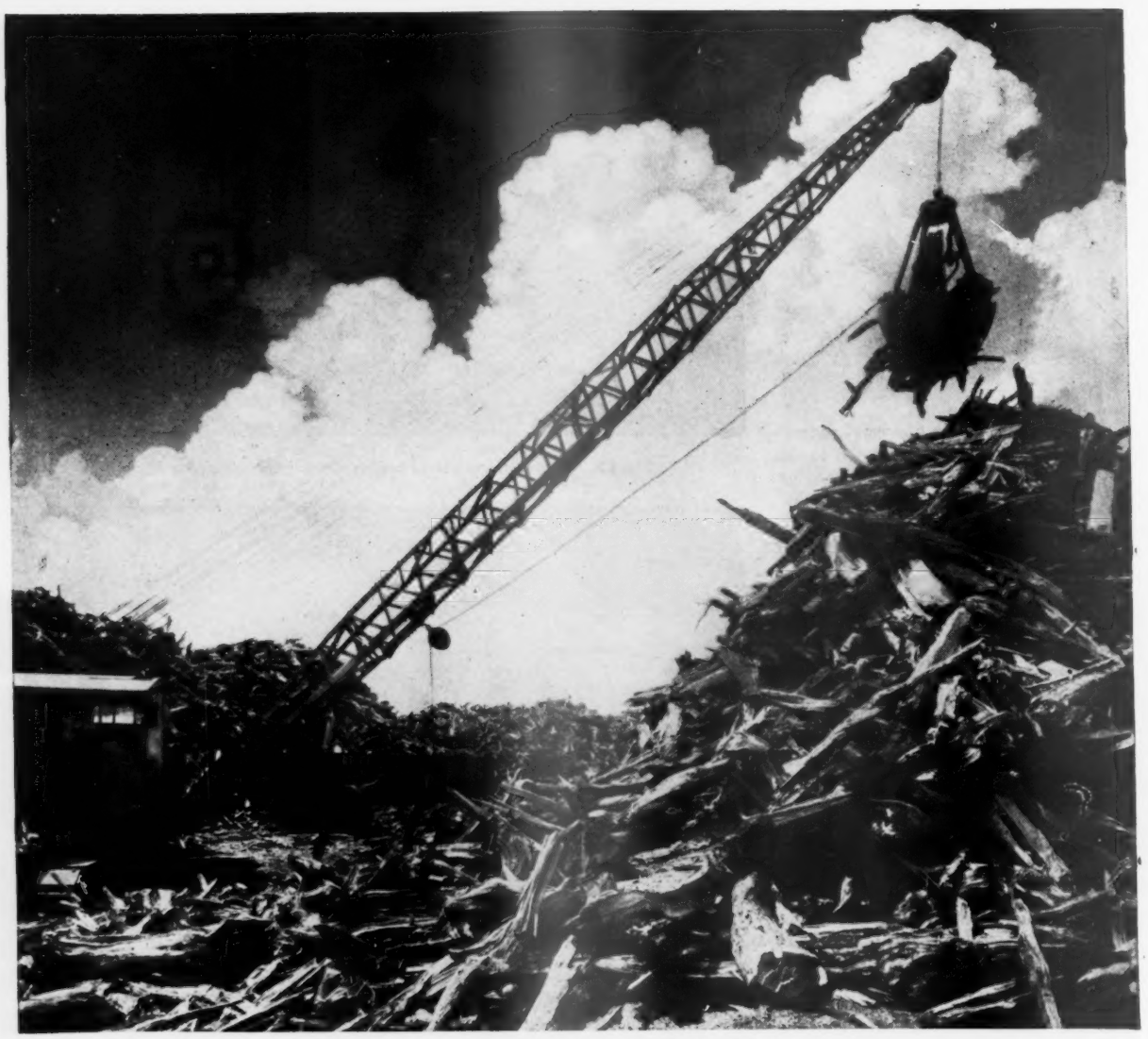
[10] Rhode, R. V., *Gust Loads on Airplanes,* SAE Journal (Transactions), Vol. 4, No. 3, pp. 81–88, March, 1937.

[11] Kaul, H. W., *Statistical Analysis of the Time and Fatigue Strength of Aircraft Wing Structures,* N.A.C.A. T.M. No. 992, Washington, D.C., October, 1941.

[12] Battelle Memorial Institute, *Prevention of the Failure of Metals Under Repeated Stress,* p. 4; John Wiley & Sons, Inc., New York, 1941.

[13] Almen, J. O., *On the Strength of Highly Stressed Dynamically Loaded Bolts and Studs,* SAE Journal (Transactions), Vol. 52, No. 4, pp. 151–158, April, 1944.

[14] Hoben, H. E., *Fatigue Failures Affecting Transport Aircraft,* presented at the Tenth Annual Meeting of the Institute of the Aeronautical Sciences, Inc., New York, January, 1942.



Found in a heap of pine stumps . . . a way to make tires better

SOME sort of soap is used in making all types of synthetic rubber for tires. At first, it was soap derived from animal fats. But out of pine stumps, like those in the picture, came the answer to making better tire synthetic rubber.

That answer is to use soap made from the *rosin* in pine stumps. B. F. Goodrich developed a new synthetic —GRS-10—with this important difference: Tires were made from the new rubber, and tests proved them so far superior that the development became an important military secret.

Tires made from the new rubber give more wear than tires made from ordinary synthetic. They run cooler. The rubber is more flexible, which is important in controlling cracking under heavy loads. Tires keep their strength. Tire life is increased.

Now all the synthetic rubber used in B. F. Goodrich airplane tires is the new GRS-10. That is typical of the B. F. Goodrich policy to make their Airplane Silvertowns always the finest, safest airplane tires on the market. That policy has caused B. F. Goodrich low-pressure Silvertowns to be the favorite of airline and private pilots for years. *The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.*

Skyway or Highway

B.F.Goodrich

FIRST IN RUBBER

Institute News

Dr. Harold Roxbee Cox Delivers Wright Brothers Lecture for 1945

Dr. Harold Roxbee Cox, Chairman and Managing Director of Power Jets (Research and Development) Limited and Vice-President of The Royal Aeronautical Society, delivered the Ninth Wright Brothers Lecture on December 17 in the U.S. Chamber of Commerce Auditorium in Washington, D.C. Presented each year to commemorate the first flights of the Wright Brothers, December 17, 1903, the Lecture was endowed following its inauguration in 1937 by the Vernon Lynch Fund, established by the late Edward C. Lynch in memory of his brother.

The program was opened by Charles H. Colvin, President of the Institute, who read the following cablegram from John Laurence Pritchard, Secretary of The Royal Aeronautical Society and an Honorary Member of the Institute:

> On the occasion of the reading of the Wright Brothers Lecture by one of our Vice-Presidents, Dr. H. Roxbee Cox, the President and Council send you their heartiest greetings and wish me to convey to you how gratified they are by the ever increasing cooperation between the Institute and the Society, a cooperation which can only be to the advantage of aeronautical technical progress in both countries.
>
> J. Laurence Pritchard

Mr. Colvin then introduced Dr. Hugh L. Dryden, Chief, Mechanics and Sound Division, National Bureau of Standards, and a Past-President and Honorary Fellow of the Institute, as Chairman of the Lecture.

Dr. Dryden spoke briefly about the Vernon Lynch Fund, explaining that the Wright Brothers Lecture is given one year by a guest from abroad and the next year by an American. He expressed the good fortune of the Institute in having, as the 1945 lecturer, Dr. Harold Roxbee Cox.

Dr. Cox's subject was "British Aircraft Gas Turbines." He opened the Lecture with a historical account of the early work of British scientists in the field of aircraft gas turbines. Emphasis was given to the collaboration between Great Britain and the United States and between Great Britain and the British Dominions in connection with the problems of research and development of the gas turbine engine.

Dr. Harold Roxbee Cox.

The present gas turbine was then discussed, together with aircraft design changes made possible by the advent of the gas turbine principle. Of these changes, Dr. Cox noted particularly the violent forward or backward sweep of leading edges, the opportunity of absorbing the power plant entirely into the wing, and the shortening of the undercarriage. He anticipates greater insistence than ever on smooth surfaces, with a consequent reaction on structural method. The possibilities of unorthodoxy in aircraft design were admitted, though seemingly distant at this time.

Dr. Hugh L. Dryden.

There followed a comparison of the Allied with the German effort. Dr. Cox stated that German production of operational gas turbine aircraft was well ahead of the Allied effort, but the Luftwaffe had accepted delivery of engines that the British and American air forces would have found completely unacceptable because of their short running lives and inadequate reliability. He cited the poor liaison between the engine designers and the research workers in Germany.

Prepared discussions of the Lecture were given by Col. Donald J. Keirn, Power Plant Laboratory, Engineering Division, Air Technical Service Command; Carlton Kemper, Executive Engineer, Aircraft Engine Research Laboratory, National Advisory Committee for Aeronautics; R. P. Kroon, Manager of Engineering, Aviation Gas Turbine Division, Westinghouse Electric Corporation; and Donald F. Warner, Assistant Designing Engineer, Aircraft Gas Turbine Engineering Division, General Electric Company.

At the conclusion of the discussions, Dr. Dryden thanked Dr. Cox for his lecture. He expressed regrets that Dr. George W. Lewis, Director of Aeronautical Research, National Advisory Committee for Aeronautics, could not attend because of illness. He stated that a letter would be sent to Dr. Lewis, expressing hopes for an early recovery.

The complete lecture and discussions will be published in the February issue of the JOURNAL OF THE AERONAUTICAL SCIENCES.

A list of some of the guests present at a reception for Dr. Cox at the Army and Navy Club follows.

Flight Lieutenant R. B. Anderson, Royal Australian Air Force Representative.

George W. Brady, Chief Engineer, Curtiss-Wright Corporation, Propeller Division.

Harold H. Budds, Vice-President and General Manager, Ranger Aircraft Engines.

Col. Donald J. Keirn.

Hon. W. A. M. Burden, Assistant Secretary of Commerce.

Wing Commander K. E. Campbell, Royal Australian Air Force Representative.

Dr. J. G. Coffin, Assistant Director of Research, Fleetwings Division of Kaiser Cargo, Inc.

Charles H. Colvin, President, Institute of the Aeronautical Sciences.

J. W. Crowley, Jr., Acting Director of Aeronautical Research, N.A.C.A.

R. H. Depew, Jr., Manager, Special Projects, Fairchild Aircraft Division, Fairchild Engine and Airplane Corporation.

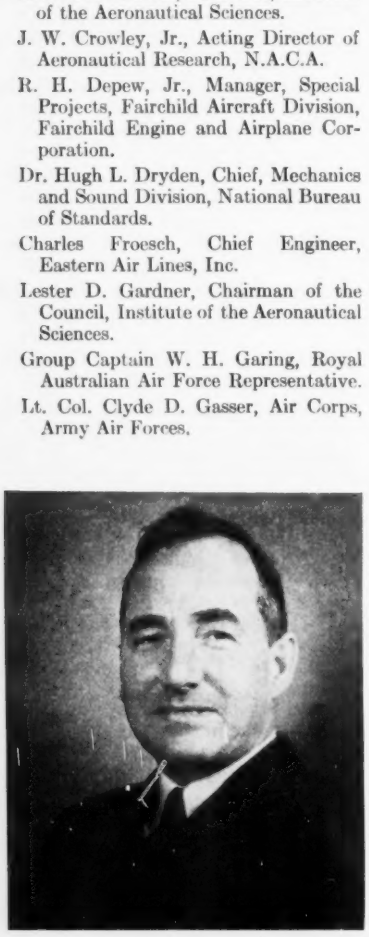
Dr. Hugh L. Dryden, Chief, Mechanics and Sound Division, National Bureau of Standards.

Charles Froesch, Chief Engineer, Eastern Air Lines, Inc.

Lester D. Gardner, Chairman of the Council, Institute of the Aeronautical Sciences.

Group Captain W. H. Garing, Royal Australian Air Force Representative.

Lt. Col. Clyde D. Gasser, Air Corps, Army Air Forces.



Carlton Kemper.

John H. Geisse, Assistant to the Administrator for Personal Flying Development, C.A.A.

R. T. Goodwin, Manager, Aviation Department, Shell Oil Company.

Lt. Col. D. Gureev, Engineering Department, The Government Purchasing Commission of the Soviet Union in the U.S.A.

R. Paul Harrington, Head of Department of Aeronautical Engineering, Polytechnic Institute of Brooklyn.

R. M. Hazen, Vice-President and Chief Engineer, Allison Division of General Motors.

Squadron Leader T. Hollinrake, Royal Australian Air Force Representative.

Bennett H. Horchler, Executive Vice-President, Institute of the Aeronautical Sciences.

William S. Hough, Staff Manager, Aircraft Section, Johns-Manville Sales Corporation.

Dr. J. C. Hunsaker, Chairman of the Executive Committee, N.A.C.A.

G. A. Hyland, Manager, Sales Department, Aviation Gas Turbine Division, Westinghouse Electric Corporation.

C. S. (Casey) Jones, President, Casey Jones School of Aeronautics.

Col. D. J. Keirn, Air Technical Service Command, Wright Field.

Carlton Kemper, Executive Engineer, N.A.C.A.

Otto E. Kirchner, Director of Research and Development, American Airlines, Inc.

R. P. Kroon, Manager of Engineering, Westinghouse Electric Corporation.

Brig. Gen. F. P. Lahm, retired.

Rear Adm. E. S. Land, retired, Chairman, U.S. Maritime Commission.

Robert B. Lea, Vice-President, Sperry Gyroscope Company, Inc.

John C. Leslie, Vice-President, Transatlantic Operations, Pan American Airways System.

Col. Charles L. Lindbergh.

Grover Loening, Aircraft Consultant, N.A.C.A.

Peter Masefield, Civil Air Attaché, British Embassy.

C. J. McCarthy, Vice-President, United Aircraft Corporation.

Rear Adm. H. B. Miller, Director, Executive Office of the Secretary, Office of Public Information, Navy Department.

Col. T. de Witt Milling, Decorations Board, War Department.

Squadron Leader J. L. Mitchell, Assistant Air Attaché, British Embassy.

N. S. Muir, Chief, Engine Development Section, British Air Commission.

Arthur Nutt, Director of Engineering, Aviation Division, Packard Motor Car Company.

R. P. Kroon.

Hon. L. Welch Pogue, Chairman, Civil Aeronautics Board.

Dr. F. W. Reichelderfer, Chief, U.S. Weather Bureau.

Rear Adm. L. B. Richardson, Bureau of Aeronautics, Navy Department.

W. A. Shrader, Editor, AERONAUTICAL ENGINEERING CATALOG, Institute of the Aeronautical Sciences.

J. Parker Van Zandt, Director, The Brookings Institution.

John F. Victory, Executive Secretary, N.A.C.A.

Dr. Th. von Kármán.

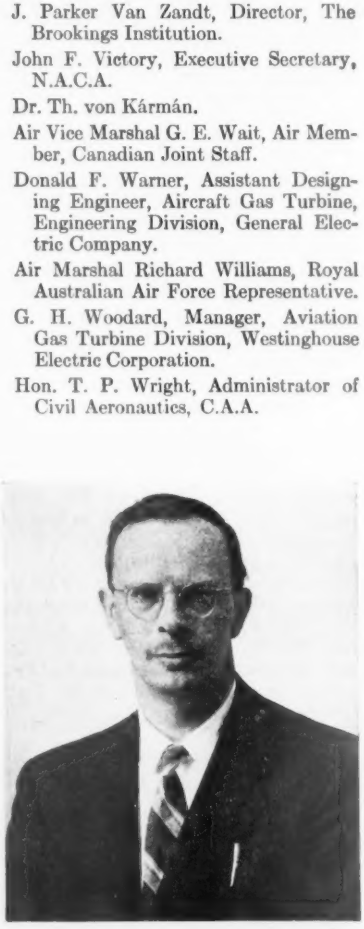
Air Vice Marshal G. E. Wait, Air Member, Canadian Joint Staff.

Donald F. Warner, Assistant Designing Engineer, Aircraft Gas Turbine, Engineering Division, General Electric Company.

Air Marshal Richard Williams, Royal Australian Air Force Representative.

G. H. Woodard, Manager, Aviation Gas Turbine Division, Westinghouse Electric Corporation.

Hon. T. P. Wright, Administrator of Civil Aeronautics, C.A.A.



Donald F. Warner.

New I.A.S. Constitution Approved by Members

At a meeting of the Council of the Institute on Thursday, December 6, 1945, the Committee of Tellers appointed by the Council announced that the new Constitution of the Institute, which had been submitted for the approval of voting members, had been approved by a majority of those voting.

The work of revising the Constitution was begun late in 1944, in consultation with Sections of the Institute, to provide for direct representation on the Council from Sections of the Institute throughout the United States, and to correctly reflect the increase in activities of the Institute.

One of the most important changes made has been the expansion of the Council from twelve to 28 members. Fifteen members of the Council will be elected to serve 3 years each, and six members of the Council, who will serve for terms of 1 year each, will be nominated by the Sections of the Institute in the Eastern, Central, and Western areas of the United States. The members of the Council nominated by Sections will be known as Area Councilors.

Six officers of the Institute will also become members of the Council. The Past-President of the Institute will also serve as a member of the Council.

The new Constitution permits the organization of Sections and Branches of the Institute under rules and regulations established by the Council. It also provides for the establishment of permanent committees and the organization of new committees to coordinate the various activities of the Institute.

Although the new Constitution is officially in effect, the new Council of the Institute cannot be elected until the Annual Business Meeting in January. Copies of the new Constitution have been sent to all members of the Institute, and additional copies are available upon request.

Standard Constitution for Sections Approved by Council

With the assistance and suggestions of Sections of the Institute, a Standard Constitution for Sections has been formulated and was approved by the Council of the Institute at their meeting on Thursday, December 6, 1945.

The Standard Constitution for Sections is intended to facilitate the operation of Sections of the Institute which do not have building facilities. The Constitution provides for the general operation of Sections and allows the adoption of By-Laws to fit the needs of individual Sections. Members of the Institute interested in organizing local Sections of the Institute may obtain copies of this Standard Constitution for Sections upon request.

Brig. Gen. John S. Allard *(right)*, shown with Lord Halifax and Lt. Gen. James H. Doolittle *(left)*.

General Arnold Receives Awards

General of the Army H. H. Arnold, Commanding General of the U.S. Army Air Forces and an Honorary Fellow of the Institute, has been awarded the Hubbard Gold Medal of the National Geographic Society "for outstanding accomplishments in the field of geography and allied sciences." The Hubbard Medal and the National Geographic Society Special Medal are awarded for outstanding work in research and exploration. The presentation was made by President Truman in a ceremony at the White House.

General Arnold was also the recipient of a life membership in the American Legion, at a dinner and reception held in New York on November 9. He was given a reproduction in gold of the life membership card of the Legion, presented by Col. LeRoy A. Mullen, Commander of Aviators Post, No. 743, of the Legion. General Arnold was introduced by Capt. Edward V. Rickenbacker, President of Eastern Air Lines, Inc.

Lt. Gen. Doolittle Rejoins Shell Union Oil Company

Lt. Gen. James H. Doolittle, former commander of the Eighth Air Force and a Fellow and Past-President of the Institute, has rejoined Shell Union Oil Company, Inc., as Vice-President.

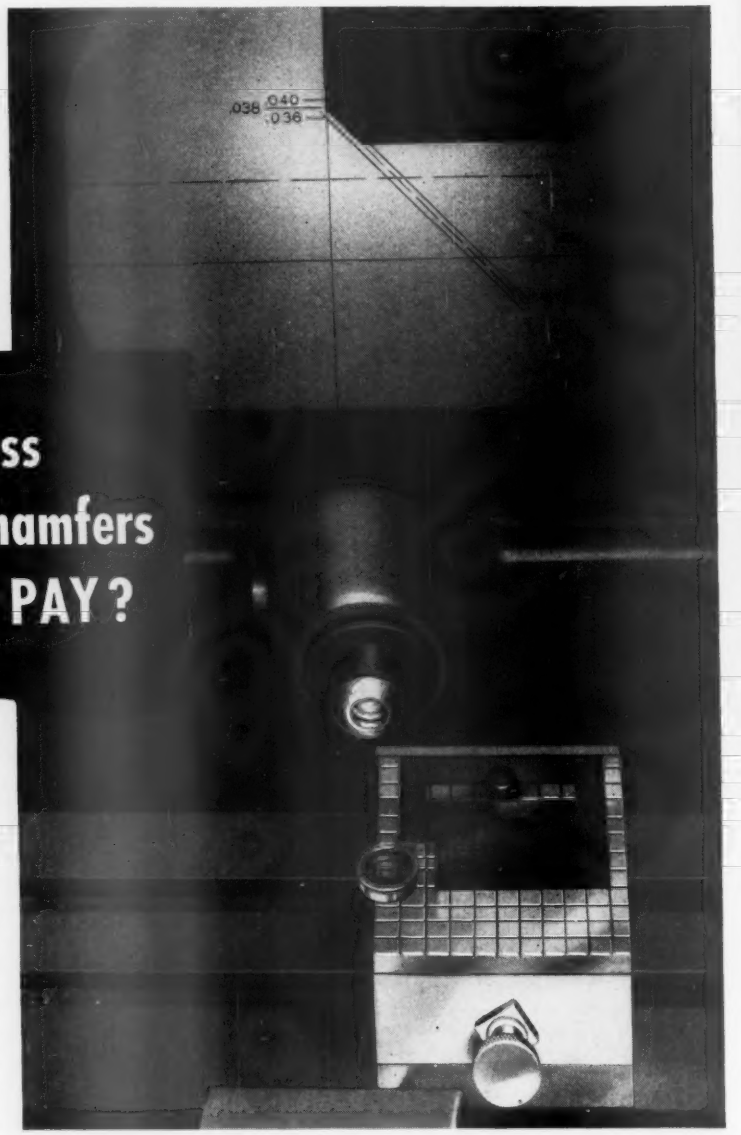
General Doolittle served in the Army Air Forces from 1917 to 1930, when he joined Shell Oil Company, Inc. He was Manager of the Aviation Department until 1940, when he was recalled to active duty in the U.S. Army Air Forces. He has been on duty in the office of the Commanding General, U.S. Army Air Forces, since the close of the war and his return from Okinawa.

General Doolittle will make his headquarters in New York, where his duties, in addition to general corporate responsibilities, will include coordination of the aviation interests of the Shell companies in the United States, and assistance in the world-wide aviation activities of the Shell group of associated companies.

General Allard Honored by Britain

Brig. Gen. John S. Allard, formerly a Vice-President of Curtiss-Wright Corporation, has been made an Honorary Commander of the Order of the British Empire, for his service as Deputy Chief of Staff and as Chief of Staff of the Eighth Air Force during the Allied invasion of Europe. The presentation was made by Lord Halifax, British Ambassador to the United States, on behalf of King George VI, the ceremonies taking place at the British Embassy in Washington.

General Allard was praised for "exceptional organizational skill in maintaining the highest standard of administrative efficiency throughout the Eighth Air Force, despite the intricate problems arising from rapidly changing operational conditions. The initiative and astute judgment displayed by General Allard in his arduous duties have been tangible factors in the success of the large-scale operations of both heavy bombers and fighters of the Eighth Air Force during the crucial period preceding D-Day and the significant months following."



If it pays to fuss about details like chamfers ... WHO DOES IT PAY?

After all, what's a chamfer on a ball bearing? Just the bevel on the edges of the outer ring that permits the staking or spinning operation to hold the bearing securely in the housing . . . almost the smallest detail. Is it worth enough to plane builders and maintenance people to be worth checking the chamfers on every single aircraft bearing with a comparator, as Fafnir does?

It wouldn't pay Fafnir to do such expensive inspection unless somebody was willing to pay for the certainty that every chamfer on every bearing was exactly right. Naturally, they'd be the people who couldn't afford to take chances on even one bearing failure . . . the men who design and make most of the military, commercial and private planes in America . . . who buy more Fafnirs than ball bearings of all other makes put together.

Of course, chamfers accurate to the thousandths of an inch are just as important to maintenance people as they are to plane makers. The precise contours of the chamfers on Fafnir Bearings make installation and removal of bearings many times quicker and easier. There are no compensations to be made for irregularities . . . and no uncertainties about the finished job.

Granted, it's easy enough to see how large plane makers and maintenance shops could go in for extreme care . . . and make it pay. Their customers expect such perfection. Maybe your business *is* as different. And maybe *your* customers are different. All that Fafnir is suggesting is that it might be something worth talking over with your shop men. The Fafnir Bearing Company, New Britain, Connecticut.

FAFNIR

BALL BEARINGS

For Aircraft

New Corporate Member

Jacobs Aircraft Engine Company, a division of Republic Industries, Incorporated, of Pottstown, Pa., has recently become a Corporate Member of the Institute.

One of the most important current activities of the company is the completion of a newly developed four-cylinder opposed engine in the 100-hp. category. It is a liquid-cooled engine considered by the manufacturer as offering several advantages. Meanwhile, the company has redesigned its L-4 engine (Army designation R-755-9), which has received an Air Transport Command rating of 300 hp. at 2,200 r.p.m., without change in size or weight. The old 330 Jacobs is likewise being redesigned and is expected to be approved for 375 to 400 hp., without increase in size or weight. These three engines are the only new types the company expects to have in production by the end of 1946, but others are being developed.

With regard to the company's line of standard engines, full production is scheduled to be attained by March or April, with a minimum rate of 100 engines per month, or twice as many as were produced before the war. No estimate is available with regard to the rate of production of the newer models. While the company has a quantity of tentative engine orders, current problems involve the obtaining of materials and freeing of machines for production.

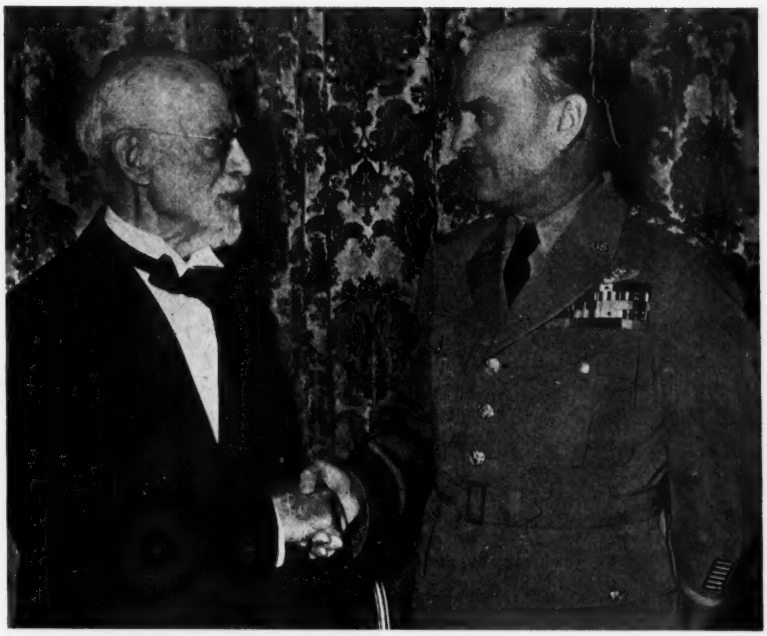
Corporate Members Expand

Curtiss-Wright Corporation has acquired the Marquette Metal Products Company, of Cleveland, Ohio, manufacturers of precision parts and assemblies for the automotive and aviation industries since 1920.

The Marquette company's products include Diesel-engine governors, fuel injectors for internal-combustion engines, compressors, electric-razor parts, and a newly developed roller-bearing spindle for the textile industry. G. W. Vaughan, President of Curtiss-Wright Corporation, will assume the chairmanship of the board of directors of the Marquette company.

Fairchild Engine & Airplane Corporation has created a new division, the Fairchild Personal Planes Division, to handle the design, manufacture, sales, and service of private-owner aircraft. The transfer of this program from the Fairchild Aircraft Division will enable the latter to concentrate on military, naval, and commercial aircraft.

The new division will offer an improved version of the F-24, named the Forwarder, a four-place, high-wing cabin plane, a military version of which was built for the Army during the war and designated as the UC-61. A choice of two engines will be offered, a seven-cylinder Warner 165-hp. air-cooled radial engine, or a Ranger six-cylinder 175-hp. air-cooled in-line engine. The Ranger-powered F-24 will have a maximum speed of 133 m.p.h., cruising speed of 118 m.p.h., and maximum range of 620 miles. Both models will have service ceilings of 14,000 ft. Tentative orders in substantial quantity have been received for the new F-24.



Dr. William Frederick Durand, 1945 recipient of the A.S.M.E. Medal (left), being congratulated by Lt. Gen. Ira C. Eaker, Deputy Commander, U.S. Army Air Forces.

Republic Aviation Corporation has entered into an agreement to purchase outright the Aircooled Motors Corporation, of Syracuse, N.Y. The purchase, involving $1,500,000, brings to Republic all rights for the manufacture of the Franklin airplane engines, widely used by the Army during the war and scheduled to be used in postwar light planes.

The Republic Seabee, a four-place amphibian personal plane now being built, will be powered by a Franklin 212-hp. engine. Accordingly, an important percentage of Aircooled Motors' production is scheduled for Republic. In addition to Republic requirements, the company reports a current backlog of $2,000,000 in orders for the Franklin engines, and other orders are in the process of negotiation. Plans for the purchase of new tooling to handle the increased schedules are well under way.

The acquisition of the engine plant rounds out Republic's production program, which includes, in addition to the Seabee, the manufacture of the Rainbow transport, and continuing military contracts.

Alfred Marchev, President of Republic and an Associate Fellow of the Institute, will become Chairman of the Board of Aircooled Motors Corporation.

Gifts to the Aeronautical Archives

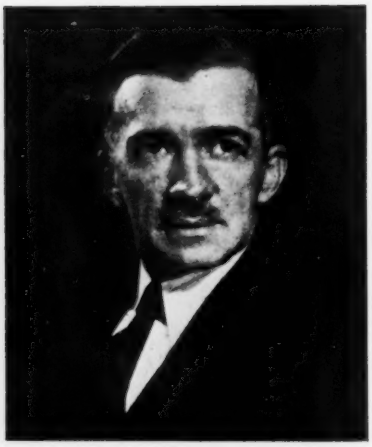
Mrs. Samuel Cabot gave letters and clippings of Samuel Cabot, including letters from Octave Chanute, and issues of *La Vie au Grand Air* for 1910. The clippings and letters add to the resources of the Aeronautical Archives on the history of American aeronautics before the turn of the century. A photostatic copy of a letter of M. Paul Lacoin to Mme. Lacoin, carried from Paris by balloon September 29, 1870, and a translation of the letter, were received from Ralph M. Eastman.

A 36-in. globe, used in planning worldwide air routes pioneered by the Pan American Airways System, was received from Juan T. Trippe. Photographs of airplanes built by the Boeing Aircraft Company, and lists of the airplanes, were received from that company through the courtesy of Harold Mansfield. The Port of New York Authority, through the courtesy of J. C. Buckley, gave an analysis of 1940 registered aircraft in municipalities and counties in each state within and beyond the New York metropolitan region.

The Bendix Aviation Corporation gave the *American Aviation Daily* for 1943, 1944, and 1945. A catalog of about 1913, of the E. B. Heath Aerial Vehicle Company, of Chicago, was received from the Koppers Company, Inc., through the courtesy of Carl D. Ulmer. A translation of a paper by K. Magnus, "The Behavior of the Pendulum Inclinometer in Moving Aircraft," from *Luftfahrtforschung*, December, 1942, was sent by Specialties, Inc., through the courtesy of E. S. Gwathmey and August Raspet.

(*Continued on page 31*)

Institute Officers for 1946



P. R. Bassett, *Vice-President.*

John C. Leslie, *Vice-President.*

J. H. Kindelberger, *Vice-President.*

Institute officers for 1946 have been elected by the Council as follows:

President—ARTHUR E. RAYMOND, Vice-President in Charge of Engineering, Douglas Aircraft Company, Inc.

Vice-Presidents—P. R. BASSETT, President, Sperry Gyroscope Company, Inc.; J. H. KINDELBERGER, President, North American Aviation, Inc.; JOHN C. LESLIE, Vice-President of Transatlantic Operations, Pan American Airways System; BURDETTE S. WRIGHT, Vice-President in Charge of the Airplane Division of Curtiss-Wright Corporation.

Arthur E. Raymond, *President.*

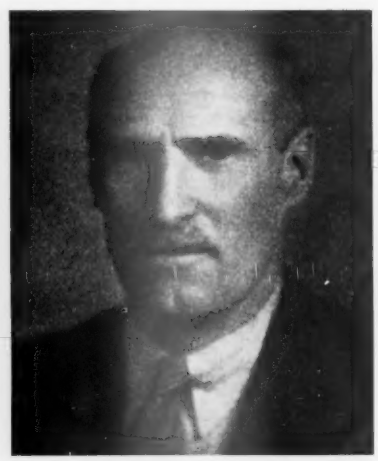
Treasurer—C. S. JONES, President, Casey Jones School of Aeronautics.

Chairman of the Council—LESTER D. GARDNER.

Administrative Committee—BENNETT H. HORCHLER, Executive Vice-President; GEORGE R. FORMAN, Assistant to the President; ROBERT R. DEXTER, Secretary; JOSEPH J. MAITAN, Controller.

Members of the Advisory Board for 1946 and new members of the Council will be announced in a forthcoming issue of the REVIEW.

Burdette S. Wright, *Vice-President.*



C. S. Jones, *Treasurer.*

Lester D. Gardner, *Chairman of the Council.*

Bennett H. Horchler,
Executive Vice-President.

(*Continued from page 29*)

Paul K. Guillow gave a Lindy Flying Game, adding to his previous generous gifts. The Aeronautical Digest Publishing Company added 104 issues of foreign aeronautical periodicals to its previous generous gifts. The Glenn L. Martin Company sent three bound volumes of *The Martin Star*, through the courtesy of Avery McBee. Translations of captured German documents were received from the Air Technical Service Command at Wright Field. Mrs. Bella C. Landauer added aeronautical books to her previous generous gifts.

Documents relating to applications before the Civil Aeronautics Board for new air routes and extensions of existing routes were received from Braniff Airways, Inc., Eastern Air Lines, Inc., Pan American Airways, Inc., Parks Air Transport, Inc., Transcontinental and Western Air, Inc., and United Air Lines, Inc.

Additional gifts were received from the American Society for Testing Materials, British Information Services, D. B. Steinman, and the U.S. Army Service Forces, Ninth Service Command of the Army Service Forces, Civil Aeronautics Administration, Civil Aeronautics Board, Securities and Exchange Commission, and Senate committees on military affairs and naval affairs.

Robert R. Dexter, *Secretary.*

Sections and Branches

Buffalo Section

On December 4, the Buffalo Section held a meeting at the Hotel Westbrook under the chairmanship of Robert A. Wolf, Vice-Chairman of the Section. Mr. Wolf announced that, prior to the next meeting, a new Chairman will be appointed by the Advisory Committee to replace E. E. Foster, who has resigned because he has left the area. Mr. Foster's letter of resignation was read. H. V. Hawkins introduced a motion to the effect that the Vice-Chairman should be empowered to appoint, with the consent of the Advisory Committee, a representative of the Buffalo Section to serve on the Nominating Committee for Area Councilors. The motion was seconded and carried by unanimous vote.

Dr. C. C. Furnas, Director of the Research Laboratories at the Curtiss-Wright Corporation, spoke on "Atomic Power Application to Aircraft." The speaker briefly reviewed nuclear physics with particular reference to the atomic bomb project, stating that atomic disintegration is not new, taking place constantly in various ways, including radioactivity, and, in the case of the sun, it has been our sole source of energy appearing in many varied forms. Thus, nuclear disintegration is looked upon as a source of energy, or a fuel. If a controlled "triggering" process could be devised, this fuel might be adapted to such uses as a steam boiler incorporating uranium salt solution, ram jets, or nuclear bombardment of a sensitive plate to produce electric current, analogous to the photoelectric cell. Dr. Furnas included among the outstanding problems to be solved heat transfer, emanation of lethal gamma rays, and development of a method for controlling the fission process to avoid catastrophic explosions. The speaker answered questions from the floor following his address.

At the next meeting, to be held in January, Alfred Marchev, President of Republic Aviation Corporation, will speak on "Simplified Design for Low Cost Airplanes."

Detroit Section

The first meeting of the 1945–46 season was held at the Engineering Society of Detroit on November 15. Arthur A. Locke, Section Chairman, discussed the papers that were presented at the Institute's Third National Air Transport Meeting in Washington, D.C., on October 25. The speaker gave résumés of the following papers: "Trends in Aircraft Instrument Development," by O. E. Esval, of the Sperry Gyroscope Company; "Economic Aspects of the Helicopter in Transport Operation," by Frank Piasecki, of P-V Engineering Forum; "Flying Boats," by Capt. C. H. Schildhauer, of the Naval Air Transport Command; and "Standardization of Navy Cockpit Arrangement," by Rear Adm. Luis de Florez.

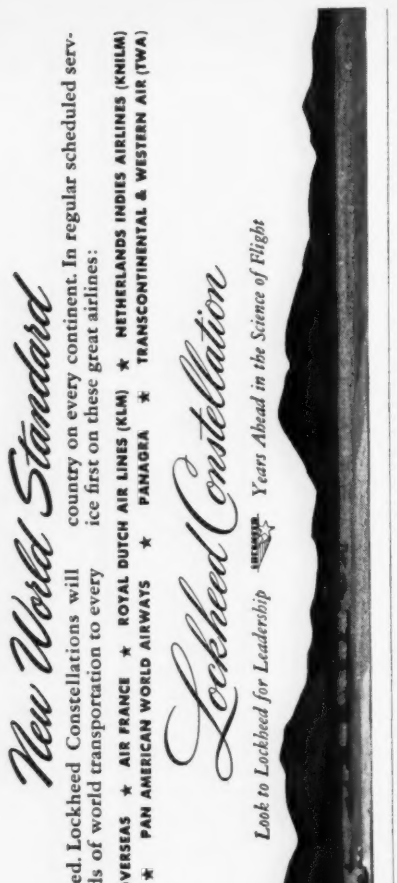
Before opening the program, the members held a dinner in the main dining room.

George R. Forman,
Assistant to the President.

Los Angeles Section

On October 15 a business meeting of the Los Angeles Section was held at the residence of Arthur E. Raymond, Chairman of the Section, who presided. The meeting was attended by Section officers C. L. Johnson, Vice-Chairman; W. J. Cerny, Treasurer; and E. J. Horkey, Secretary; and by W. H. Dudley, Pacific Coast Executive of the Institute. Mr. Raymond spoke about the Constitution that is being prepared for the Los Angeles Section, pointing out that a Constitution for the Section is necessary because of the matters en-

Joseph J. Maitan, *Controller*


New World Standard
The claim is proved. Lockheed Constellations will bring new standards of world transportation to every country on every continent. In regular scheduled service first on these great airlines:
AMERICAN AIRLINES OVERSEAS ★ AIR FRANCE ★ ROYAL DUTCH AIR LINES (KLM) ★ NETHERLANDS INDIES AIRLINES (KNILM)
EASTERN AIR LINES ★ PAN AMERICAN WORLD AIRWAYS ★ PANAGRA ★ TRANSCONTINENTAL & WESTERN AIR (TWA)
Lockheed Constellation
Look to Lockheed for Leadership
Years Ahead in the Science of Flight

tailed in the establishment of permanent quarters, and because of the local section constitutions of other engineering societies. Final revisions to the Constitution were discussed, and it was planned to submit the Constitution to the members of the Section and to the New York headquarters of the Institute for approval.

Consideration was given to the annual reports of the Secretary and Treasurer, prior to their submission to the Institute.

It was decided that at the next business meeting the Constitution would be discussed and copies submitted to all members by mail; officers for the coming year would be nominated; and further reports of the status of the building plans would be presented. It is planned to submit the question of Section dues to a vote, to be taken by mail.

Mr. Dudley reported on the action of the San Diego Section relative to a local Constitution.

New York Section

Dr. Alexander Klemin was the principal speaker at a meeting of the New York Section held on November 19 in the McGraw-Hill Building Auditorium. Approximately 200 members and guests attended.

The subject of Dr. Klemin's talk was "The Imminence of the Helicopter in Civil Aviation." At the conclusion of the talk, Robert A. Wolf, Chief Engineer of the Helicopter Division of Bell Aircraft Corporation, led a discussion of the subject and showed a film on autorotation studies of the helicopter.

Stanley Hiller, Jr., exhibited films of his coaxial-type helicopter. George H. Miller, Chief of Flight Test at Platt-Le Page Aircraft Company, presented films of the helicopter in connection with his contribution to the consideration of various aspects of rotating wing aircraft.

Philadelphia Section

At a meeting of the Philadelphia Section held on October 23 at the Engineers' Club of Philadelphia, the following Committee Chairmen were chosen: Membership, Carl de Ganahl; Publicity, R. Wiese; Fellowship, J. Rogers. The affiliation of the Section with the Engineers' Club of Philadelphia, to provide a regular meeting place, was considered. A program for the monthly meetings through June, 1946, was announced, followed by a discussion of the topic "Do Aircraft Methods of Engineering and Fabrication Contribute to Other Industries?" The speakers were J. Garges, of Eastern Aircraft Division of General Motors Corporation; M. Watter, of E. J. Budd Manufacturing Company; R. Wiese, of Fleetwings Division of Kaiser Cargo, Inc.; and H. R. Young, of Baldwin Locomotive Works. L. B. Kalinowski, Vice-Chairman of the Section, presided.

On November 7, a joint meeting with the Franklin Institute of Philadelphia was held at the Franklin Institute. R. P. Kroon, Manager of Engineering of the Aviation Gas Turbine Division, Westinghouse Electric Corporation, gave a lecture on "Jet Propulsion Engines and Propeller-Drive Gas Turbines—Their Application in Future Aviation." Mr. Kroon discussed the design, construction, and performance of aviation gas-turbine engines, compared them with present and proposed reciprocating internal-combustion engines, and spoke of the difficulties encountered and being met in present developments. The lecture was followed by an inspection of the engines on display.

Texas Section

The second Fall meeting of the Texas Section was held on November 15 in the Texas Hotel, Fort Worth. Wendell E. Eldred, Landing Gear Design Group Engineer, Fort Worth Division, Consolidated Vultee Aircraft Corporation, presented a paper titled "Weight Reduction of Aircraft Braking Systems Through the Use of Reverse Thrust Propellers." This paper was prepared by Mr. Eldred and Henry H. Kerr, Manager of Aeronautical Sales, Hayes Industries; and Harold H. Warden, Manager, Installation Department, Propeller Division of Curtiss-Wright Corporation.

Wichita Section

On November 29, the Wichita Section held a meeting at the University of Wichita, at which Walter Burnham, Vice-Chairman, presided. Two films were shown, one on *Selection of a Thermo Setting Plastic Material*, produced by the Bakelite Corporation; the other, a film about the Fairchild AT-21 Gunner, produced by Fairchild Engine & Airplane Corporation. Jerry Gordon, Aerodynamicist at Beech Aircraft Corporation, read his paper, "Survey of Existing Wind Tunnels," which discussed the various wind tunnels observed by the speaker on the West Coast, including those of North American Aviation, Inc., Lockheed Aircraft Corporation, Northrop Aircraft, Inc., California Institute of Technology, and the National Advisory Committee for Aeronautics.

Kenneth Razak, Associate Professor in the Aeronautics Department of the University of Wichita, read a paper on "Wind Tunnel Development of the University of Wichita." This described the program of the small-scale wind tunnel testing at the University, and outlined the specifications for a new wind tunnel that is to be built at the University in conjunction with the local aircraft manufacturers.

A business meeting also was conducted, at which the following officers for 1946 were elected: Chairman, Walter Burnham; Vice-Chairman, Kenneth Razak; Secretary, Robert W. Allred; and Treasurer, Herbert Kueck.

For the next meeting, to be held about January 10, a paper on power gliding has been scheduled.

Academy of Aeronautics

At meetings held on November 7 and November 12, Edwin Siekierski, Chairman of the Social Committee, read a progress report on plans for a social gathering, which were unanimously accepted. Thomas J. Knust, Branch Chairman, presided.

A detailed report of the expenses incurred for the Branch dance of November 17 was submitted by Alphonse Parzel at a meeting held on November 26. A Technical Data Committee was formed and it was voted to make it a permanent one, with Daniel B. McElwain appointed as Chairman. The name *Sky Hook* was adopted for the school paper.

Aeronautical University

At a business meeting held on September 5, a talk was given by Raymond B. Williams, Branch Chairman, for the benefit of new members.

On September 19 a business meeting was held, at which William Wllecko was elected Vice-Chairman. The Treasurer's report and a committee report on speakers were read and Chairman Williams spoke on "Relativity."

At a business meeting on October 3, it was decided that the formation of a flying club, suggested at a previous meeting, was not practical at present. A letter was read concerning the acceptance of new members and films were shown.

At a meeting held on October 17 there was a discussion of Einstein's "Theory of Relativity." The possibility of obtaining a lecturer on Atomics was mentioned.

The film *Wings For This Man* was shown at a meeting on October 31.

University of Alabama

At a meeting in the College of Engineering Building on November 13, the following officers were elected: William K. Rey, Chairman; Russ B. Robinson, Vice-Chairman; and David W. Crockett, Secretary-Treasurer. The aims and purposes of the Institute were described in a talk by Prof. Colgan H. Bryan, after which nonmembers present applied for membership.

The films *Attitude Gyro* and *Reconnaissance Pilot* were shown at a technical meeting on November 26, and new members were enrolled. It was decided that no further meetings would be held until January 14 because of final examinations and the holiday recess.

The Catholic University of America

At a meeting held on December 4, the following officers were elected: Chairman, Michael J. Quirk; Secretary, Richard L. Caslin; and Treasurer, Charles R. Beek. Mr. Quirk left the University in 1942 to join the U.S. Army Air Forces, in which he attained the rank of Major. His P-47 was hit by antiaircraft fire and he became a prisoner of the Germans in September, 1944. He has returned to continue his aeronautical studies.

William Green, Research Engineer, of the Engineering and Research Corporation, spoke on "The Jet and Rocket Research and Development by the Germans." Mr. Green was a member of the U.S. Army technical information unit which followed General Patton's Third Army, gathering information concerning recent German technical developments. The film *Fighter Activities over Europe* was shown.

University of Colorado

At a technical meeting of the University of Colorado Student Branch held on September 20, the film *The Bell Helicopter* was shown, followed by a social gathering. The meeting, presided over by John Fletcher, Branch Chairman, was the last of the semester.

University of Detroit

The first meeting for the semester of the Student Branch of the University of Detroit was held on October 10, at which Chairman Douglas Allison presided. The guest speaker was Prof. George H. Tweney, Acting Director of the Department of Aeronautical Engineering at the University of Detroit. He gave a short talk about the history of the Institute, its aims and accomplishments, and outlined the procedure of initiation for the benefit of prospective members. Professor Tweney described the three publications of the Institute. Maurice Roy was appointed Program Chairman for the next meeting.

On November 29 the University of Detroit Branch made a tour of the plant of the American Blower Corporation. T. A. Walters, Director of Research of the company, gave a short talk about the problems of design of fluid drives and fans, and demonstrated many of the principles involved.

At a meeting on December 6, the Treasurer gave a report about the financial standing of the Branch. After the business meeting a film titled *Wings of the Army* was shown, depicting the growth of the U.S. Army Air Forces from the early flights of the Wright Brothers up to the operation of the latest and fastest types of military airplanes.

Georgia Institute of Technology

The following officers were elected at a business meeting held on November 8: Chairman, William J. Oakes, Jr.; Vice-Chairman, John K. Wimpress; Secretary, Rial E. Rolfe, Jr.; and Treasurer, Charles H. Green, Jr. An interesting fact brought out at this meeting was the large number of men who had studied previously at other institutions. A census revealed that the members of the Branch had attended an aggregate of 28 other colleges before entering Georgia Tech.

On November 20 the meeting was devoted to a talk by Ned W. Richardson on his personal experiences in the U.S. Army Air Forces. Chairman William J. Oakes, Jr., presided.

Massachusetts Institute of Technology

On October 16 the Student Branch of the Massachusetts Institute of Technology visited the Chance-Vought Aircraft Division of United Aircraft Corporation. After being conducted through the assembly procedure of the F4U-6 Corsair, the members were taken out to the flying field and shown the completed airplanes, as well as the armament shops and bore-sighting facilities. The group also inspected experimental models of the company's present developments.

At an election meeting held on November 23, reports were read on the term's activities, by the Secretary-Treasurer, Bernard J. Haverback, and by the Program Chairman, Donald E. Robison. The following new officers were elected: Bernard J. Haverback, Chairman; Donald E. Burke, Vice-Chairman; Herbert E. Jacques, Secretary-Treasurer; and Alfred A. Little, Program Chairman. Henry W. Pickford, retiring Chairman, presided.

University of Minnesota

At a meeting held on November 5, Dr. Jean Piccard, noted scientist and Professor of Aeronautical Engineering at the University of Minnesota, described his recent trip to Europe. New members were received into the Branch at this meeting.

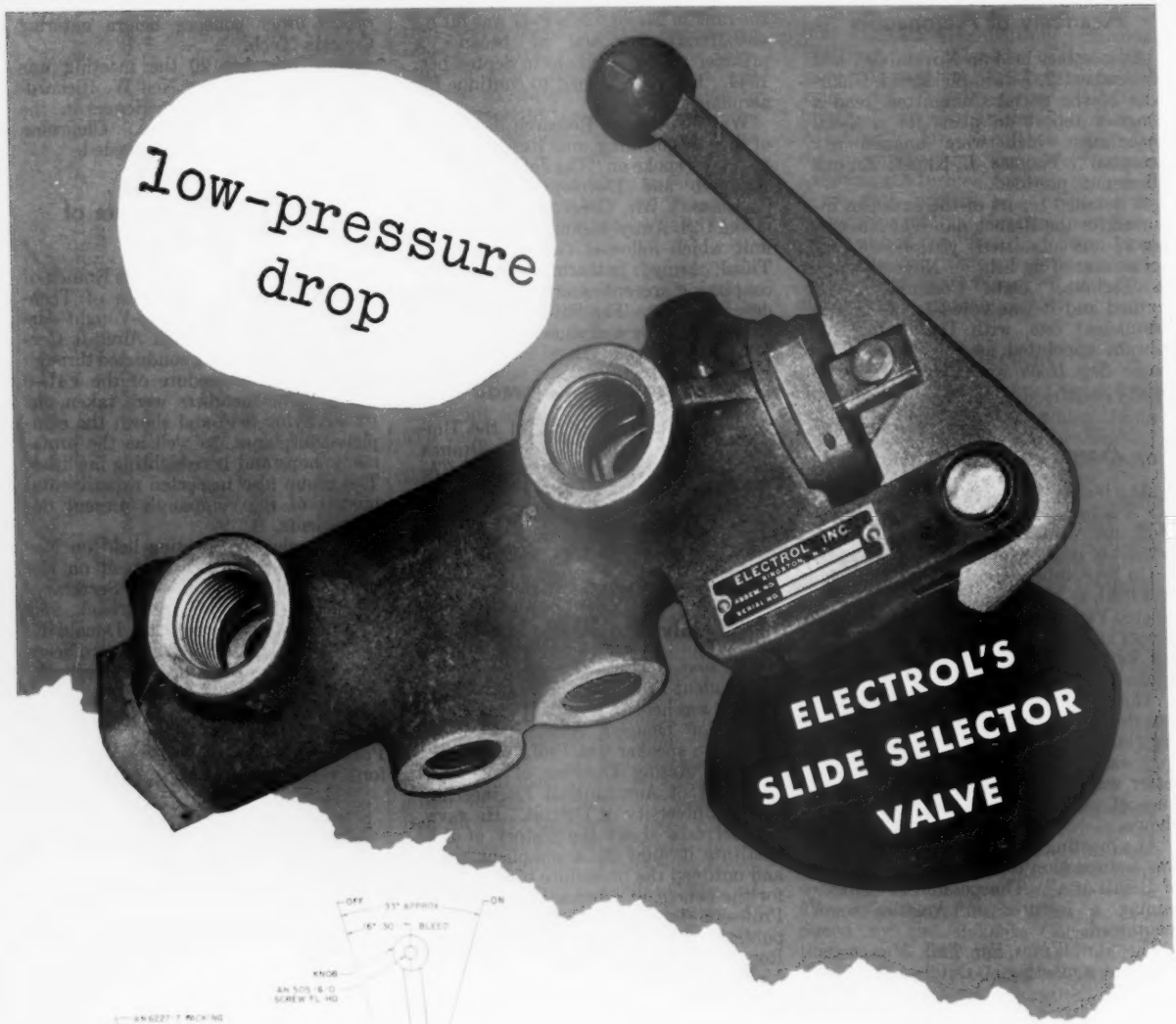
On November 20 a technical meeting was held, at which Prof. John D. Akerman related his experiences on his trip to Europe. Russell Sandahl was elected Treasurer. Plans were made for an Aeronautical Department Ball to be given in February. Colleen Sundry, Branch Chairman, presided.

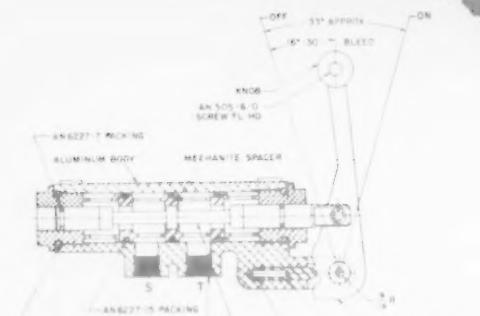
New York University

A technical meeting was held on November 14 in the Guggenheim Building, at which Martin Snyder, Branch Chairman, presided. The film *Power by Wright* was shown. Because of the shortage of time and the length of the film, a meeting on November 20 was devoted to a second showing of the picture.

University of Notre Dame

The Notre Dame Student Branch discussed plans for the coming semester at a meeting held on November 9. It was decided that the next meeting would feature the showing of one of the following films: *Keep 'Em Flying, Lockheed 14,* or *Cyclone Combustion.*





Feature of the ELECTROL slide selector valve is the machined Meehanite spacer which forms the valve seat and slide support. The Meehanite provides a smooth, self-lubricating bearing surface for the carburized and hardened steel slide. Spacer is fitted in the housing with three O-rings. Hence an aluminum plug and steel slide can be used despite their differing co-efficients of expansion. Another advantage of the design is that the slide and spacer can be matched for minimum clearance before final assembly. Thus expensive time-consuming honing and fitting operations are eliminated in manufacture. As a result, cost is low and leakage is minimized. Before you design your next control system, write ELECTROL, Kingston, N. Y.

For hydraulic control circuits in which on-off control is desired for remote units, investigate the ELECTROL slide selector valve. Simple in design and light in weight, this new valve offers engineers a service-free, low-cost control unit for positioning of remote elements. Design is such that pressure drop is a minimum of four pounds at three gallons per minute flow. Handle locks in any one of three positions: on, off or bleed. Weight is only 23 ounces.

ELECTROL
HYDRAULICS

University of Oklahoma

On November 20 a meeting held in the Engineering Auditorium was given to the showing of a film *Study of Propellers*. Refreshments were served after the meeting. T. M. Gayle, Branch Chairman, presided.

Polytechnic Institute of Brooklyn

On December 4 a business meeting was held, at which Chairman Morris Morduchow spoke briefly for the benefit of new members. Suggestions were then offered as to the proper disbursement of Branch funds, with the conclusion that the practice of serving luncheon at meetings would be discontinued and the funds customarily used for this purpose would be utilized to defray the expenses of obtaining films and lecturers for meetings. Several topics of interest to the members were offered and the Chairman solicited speakers on these topics from the undergraduate group.

Two talks to be presented at meetings in the near future are "Mach Number," by Carl Grubin and "Shock Wave," by Stanley Shatunoff.

Spartan College of Aeronautical Engineering

The films *Product Design* and *Selection of Material* were shown at the December meeting of the Spartan College Branch. These films, produced by the Bakelite Corporation, illustrate the usefulness of plastic products to the designer.

Agricultural and Mechanical College of Texas

The Student Branch at Texas A. & M. has been reactivated and the first meeting was held on November 14. An informal discussion dealt with the purposes of the Student Branch of the Institute.

On November 20 an organization meeting was held, at which the following officers were elected: Chairman, James R. Vaughan; Vice-Chairman, Robert M. Fleming; and Secretary-Treasurer, Charles F. Crabtree. The Faculty Adviser is Prof. Robert M. Pinkerton, Acting Head of the Aeronautical Engineering Department.

Attendance at each of the meetings was approximately 40.

Tri-State College

A meeting was held on November 5 in the Aero-Science Building, at which the film *Static Testing of Aircraft* was shown.

On November 12, at a combined business and technical meeting, Don McKercher read the report of the Secretary-Treasurer, following which the film *A Tour of the Piper Factory* was shown.

At a meeting on November 19, two talks were given by members. Basil Deliman spoke on "Consolidated B-24 Construction" and Joaquin Lopez gave a talk on "Aviation in Cuba." The film *Aircraft Hydraulic Systems* was shown after the talks.

A business meeting on November 26 was devoted to the reading of the Secretary-Treasurer's report by Don McKercher and a discussion about obtaining surplus Government aircraft equipment for school use. The films scheduled for this meeting were delayed, so that their exhibition was postponed and the meeting adjourned.

Chairman Walter Remy presided over all November meetings.

University of Tulsa

The newly organized Student Branch at the University of Tulsa held its first meeting on November 7 in the Phillips Engineering Building. Officers elected were: Adolf E. Kowalski, Chairman; George W. Carney, Jr., Vice-Chairman; and Constance M. Cook, Secretary-Treasurer. The second Thursday of each month was selected as the date of regular meetings. Prof. J. C. Klotz, Faculty Adviser, presided.

On November 15 Chairman Kowalski gave a talk on the "Messerschmitt Me 262." A discussion of by-laws for Student Branches took place, after which motions were passed that dues be one dollar per year and that officers be elected at the end of each school year.

News of Members

Benjamin M. Anderson has been elected President of the recently formed Anderson-Greenwood Aircraft Company.

Major Gen. Victor E. Bertrandias, formerly Vice-President of Export Sales at Douglas Aircraft Company, Inc., has returned from service with the Army Air Forces, to resume charge of export sales in the Douglas organization.

Allan F. Bonnalie has been named President and General Manager of Lineas Aereas Mexicanas, S.A., Mexican subsidiary of United Air Lines.

John J. Burns has joined Cessna Aircraft Corporation as Structural Design Engineer and Stress Analyst.

Kenneth Campbell, Senior Project Engineer of Wright Aeronautical Corporation, has been awarded the 1944 Manley Memorial Medal of the Society of Automotive Engineers for his paper "Engine Cooling Fan Theory and Practice."

A. N. Corner has formed the engineering firm of Corner Simon Associates, in New York.

Lt. James R. Craddock, recently returned from duty in the U.S. Army Air Forces, has joined The Glenn L. Martin Company as Junior Aerodynamicist.

Major Jack J. Crane has left the U.S. Army Air Forces and is a Pilot with American Overseas Airlines, Inc.

Herbert F. De Weese is now with the Flight Data Branch of the Air Technical Service Command, U.S. Army Air Forces, Wright Field, as Aeronautical Engineer.

Robert P. Dietz has been assigned as Research and Development Engineer and Pilot with the Air Technical Service Command at Wright Field.

David B. Dill is now Director of Research in the Laboratory of Industrial Physiology at Harvard University.

William R. Forsythe has left the U.S. Army Air Forces and has become a Research Engineer at the Engine Research Laboratory of the California Research Corporation, a subsidiary of Standard Oil Company of California.

Carl A. Frische, formerly Chief Research Director at Sperry Gyroscope Company, Inc., has been elected Vice-President of Engineering at that company.

William C. Gage has been promoted to the position of Aviation Sales Manager at the Allison Division of General Motors Corporation.

Richard H. Guthrie is now an Aircraft Designer at the de Havilland Aircraft Company of Canada.

Herman Halpern has joined the Fairchild Engine and Airplane Corporation as Senior Aerodynamics Engineer.

Clinton R. Hanna, has been given the degree of Doctor of Engineering by Purdue University, of which institute he is a graduate.

Ross E. Heflin has become Assistant Chief Engineer of International Aviation Corporation.

Irving D. Hirschfield has been promoted to the rank of Lieutenant Colonel as Assistant Chief of Engineering and Maintenance in the Eighth Air Force.

Lewis E. Howard, Jr., is now Chief Engineer of the Qualitrol Corporation.

Seng-Chiu Hu has become President and Chief Engineer of China Motor Corporation.

John K. Hulbert is now with the Special Projects Group at the Aircraft Laboratory of the U.S. Army Air Forces at Wright Field.

Victor A. Ivanoff, formerly Aeronautical Engineer at the Langley Memorial Aeronautical Laboratory of the N.A.C.A., has joined the Helicopter Corporation of America as Research Engineer.

Lester G. Kelso is now with the Engineering Department of United Airlines, Inc.

Julius Kendall has joined Greer Hydraulics, Inc., as Assistant to the Chief Engineer, in charge of Sales and Service.

Charles N. Kimball, Vice-President in charge of Sales Engineering at Aireon Manufacturing Corporation, has been appointed to the Emergency Services Committee of the Radio Manufacturers Association and to the Technical Committee on Railroad and Vehicular Com-

The Navy's Newest "Homesick Angel"

World's first plane with both a conventional engine plus Jet Propulsion

High speed, mile-a-minute rate of climb, exceptional maneuverability and long cruising radius — the Ryan Fireball with its combination power plant is a top performer in every way. Here is the answer to the Navy's request for a fighter which could operate from carriers and yet out-perform the enemy at all altitudes.

And for added power in an emergency or on take-offs, the big Wright Cyclone engine is equipped with a water injection system using a CECO water injection pump. This steps up the forward engine power from 1425 h.p. to 1550 h.p. — a real boost when it is needed most.

Chandler-Evans is particularly proud to have played a part in this newest addition to the great Navy team. For whether it concerns planes for war or peace, Chandler-Evans' engineering skill and knowledge always stand ready to serve America's aviation industry as new developments enter the ever-changing picture in the air.

CARBURETORS FUEL PUMPS PROTEK-PLUGS

CHANDLER-EVANS CORPORATION

WEST HARTFORD 1, CONNECTICUT, U. S. A.

CECO

munications of the Institute of Radio Engineers.

Jack D. Kominsky has joined the firm of Buensod & Stacey as Senior Draftsman.

Edward Kurzawa is now with Weatherly Campbell Aircraft as Chief Engineer.

Matthew R. Leizer has become a Designer with Mardus, Leizer & Ott.

Roy W. Lessard is now Chief of Structures at the Fairchild Aircraft Division of Fairchild Engine & Airplane Corporation.

Melvin Lindner has joined Republic Aviation Corporation as Junior Aerodynamicist.

Col. Robert M. Love, Deputy Chief of Staff of the Air Transport Command, will become President of All American Aviation, Inc.

Valentine A. Luce has joined the Cornell University Medical College as Aviation Safety Research Engineer.

Col. Carl Norcross has become a Staff Writer for *Fortune Magazine.*

Robert A. Nova is now an Engineer with Boeing Aircraft Company.

William A. O'Brien has enrolled as a student at the University of Michigan.

Fred W. Ocvirk has joined the faculty of Cornell University as Assistant Professor in Aeronautical Engineering.

Michael A. Paradiso has joined Douglas Aircraft Company, Inc., as Design Engineer (B).

John A. Parchem has become an Instructor in the Aeronautical Engineering Department of the University of Notre Dame.

W. A. Patterson, President of United Air Lines, Inc., has been elected a Director of the Air Transport Association.

Rear Adm. De Witt C. Ramsey, formerly Chief of Staff to Admiral Spruance, Commander of the U.S. 5th Fleet, has been named Deputy Commander in Chief of the Pacific Fleet.

I.A.S. Meeting Preprints

A limited number of copies of preprints of papers presented at meetings of the Institute are available for distribution, at a charge of 25 cents each to members of the Institute, and 50 cents to nonmembers, to cover handling and mailing charges. The following lists preprints available from the past three national meetings of the Institute.

SUMMER ANNUAL MEETING

Los Angeles, Calif. **August 16–17, 1945**

Aero-Medical Aspects of Cabin Pressurization for Military and Commercial Aircraft—Col. W. Randolph Lovelace, II, and Lt. Col. A. P. Gagge, Aero Medical Laboratory, Engineering Division, Air Technical Service Command, Wright Field. 11 pages; 5 illus.

Armament for Jet-Propelled Bombardment Airplanes—R. A. Averitt, Armament Section, Aviation Division, General Electric Company. 11 pages; 4 illus.

†Glass Laminates and Their Application to Aircraft Structures—Capt. George B. Rheinfrank, Jr., and Capt. Wayne A. Norman, Engineering Division, Air Technical Service Command, Wright Field. 17 pages; no illus.

Icing Problems and the Thermal Anti-Icing System—F. L. Boeke and R. A. Paselk, Heating and Ventilating Engineers, North American Aviation, Inc. 45 pages; 19 illus.

*Research and the Army Air Forces—Brig. Gen. L. C. Craigie, Chief, Engineering Division, Air Technical Service Command, Wright Field. 4 pages; no illus.

Structural Design Problems in the B-29 Airplane—George Snyder, Chief of Structural Design, Boeing Aircraft Company. 9 pages; 7 illus.

LIGHT AIRCRAFT MEETING

Detroit, Mich. **October 4–5, 1945**

Compatibility of Roadability and Landing Requirements in Aircraft Undercarriages—Reinhardt M. Rosenberg, Design Specialist, Nashville Division, Consolidated Vultee Aircraft Corporation. 25 pages; 5 illus.

Control Operation of Spratt Wing—George G. Spratt, Nashville Division, Consolidated Vultee Aircraft Corporation. 11 pages; 9 illus.

Itinerant Aircraft Radio—H. T. Sagert, Sales Manager, Aviation Radio Division, Lear, Incorporated. 25 pages; no illus.

NATIONAL AIR TRANSPORT MEETING

Washington, D.C. **October 25, 1945**

Flying Boats—Capt. C. H. Schildhauer, U.S.N.R., Naval Air Transport Service Command. 9 pages; no illus.

* Published in the October issue of the *Aeronautical Engineering Review.*

† Published in this issue of the *Aeronautical Engineering Review.*

partners in creating

●Even K & E has never devised an instrument that would make it unnecessary to *think*. But we have spent 78 years designing and producing things that make it easier to *act* after thinking . . . drafting instruments and related materials that give the engineering hand and eye almost the same precision as the engineering brain. How well K & E products serve as partners in creating is shown by the reliance placed in them by engineers and draftsmen throughout the world.

So widely is this equipment used that practically every great American engineering project has been completed with the help of K & E. Could you wish any surer guidance than this in the selection of your own instruments and materials?

To make measurements with the greatest ease and the least chance of error, choose a WYTEFACE* steel tape or tape rule of the type made especially for your work. Their jet black markings against their white background are as easy to read in the brightest glare as in the dimmest light. They are readily kept clean, are rust-resisting and hard to kink. For full information about them write to your nearest K & E Distributor or to Keuffel & Esser Co., Hoboken, N. J.

*Trade Mark *WYTEFACE Steel Tapes and Tape Rules are protected by U. S. Pat. 2,089,209*

. . . the world's finest railroads
. . . most efficient plants
K+E
Drafting, Reproduction, Surveying Equipment and Materials, Slide Rules, Measuring Tapes.
KEUFFEL & ESSER CO.
EST. 1867
NEW YORK • HOBOKEN, N. J.
CHICAGO • ST. LOUIS • DETROIT • SAN FRANCISCO
LOS ANGELES • MONTREAL

Robert Saks has joined Douglas Aircraft Company, Inc., as Engineering Designer.

Luis A. Sepulveda has joined the Mechanical Engineering Division of Public Utilities Engineering and Service Corporation.

Seymour Sherman is now connected with the faculty of the University of Chicago as Assistant Professor.

John C. Squiers has become a member of the engineering firm of Kelly, Soellner and Squiers, Inc.

Ernest G. Stout has recently returned from the Naval Technical Mission in Europe, where he observed German hydrodynamic technology specifically, and in addition visited all the important German laboratories.

Mann C. Sweet has joined Consolidated Vultee Aircraft Corporation as Engineering Draftsman.

Ray C. Tegtmeyer is now Chief Engineer of Marathon Machine Company.

Raymond H. Tomren has joined Northrop Aircraft, Inc., as Research Analyst.

George H. Tweney has been promoted to the position of Assistant Professor of Aeronautical Engineering at the University of Detroit.

Robert J. Vicars has joined the staff of The Johns Hopkins University, to engage in aerodynamic research work.

Harry F. Vickers, President of Vickers, Inc., and a Vice-President of The Sperry Corporation, has been elected a Director of The Sperry Corporation.

Rahland C. Zinn has become Assistant Division Engineer, Administrative, with Pan American Airways, Inc.

Members Elected

The following applicants for membership or applicants for change of previous grades have been admitted since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Bowers, Herbert Lee, B.Ae.E.; Chief Development Engineer, Bell Aircraft Corp.

Bruchiss, Louis, Editor, *Air Tech;* Editor, *Aerosphere.*

Buckell, Frank Edward, Manager, General Electric Co., Ltd. (England).

Bullard, Lyman Austin, Jr., B.S. in Ae.E., Chief of Flight Test Dept., Chance Vought Aircraft Div., United Aircraft Corp.

Friend, Halton Hobson, M.S. in Physics; Project Engineer, Development Div., Curtiss-Wright Corp.

Hawkins, Harold Vern, Ph.D.; Vibration Engineer, Bell Aircraft Corp.

Stanley, Robert Morris, B.S. in Ae.E.; Chief Engineer, Bell Aircraft Corp.

Wedberg, Frank Albert, B.S. in M.E.; Design Specifications Engineer, Buffalo Plant, Curtiss-Wright Corp.

Wolfe, Thomas, B.S.; V.P. in charge of Traffic Advertising and Public Relations, Western Air Lines, Inc., and Inland Air Lines.

Wood, Charles Raymond, Jr., B.S. in Ae.E.; Lt. Comdr., Sr. Project Officer, U.S. Navy.

Elected to MEMBER Grade

Aeton, George, B. of Architecture; Draftsman, Arizona State Highway Dept.

Brown, Sheldon Willis, Ae.E.; Comdr., Head, Experiments and Development Branch, U.S. Navy.

Chang, Jefferson Fuseng, B.S. in Ae.E.; Capt., Structural Engineer, Consolidated Vultee Aircraft Corp.

Fitzpatrick Patrick Leo, Chief Draftsman, Defence Forces (Ireland).

Green, Elliott Aron, B.S. in M.E.; Group Engineer, Lockheed Aircraft Corp.

Halperin, Eugene, Head of Control Lab., Research Lab., Lear, Incorporated.

MacDonald, Sandy Alexander Forsythe, Sales Manager, de Havilland Aircraft of Canada Ltd.

Mazur, John William, B.S.M.E.; Engineer, Raymond Engineering Laboratory, Inc.

Palmer, John Lee, B.Ae.E.; Lt. (j.g.), Engineering Officer, U.S. Navy.

Richards, George David, B.A.; Capt., Sr. Pilot, Air Inspector, Operations and Training, Air Transport Command, U.S. Army Air Forces.

Saffell, Herbert Ray, Jr., Research Engineer, University of Southern California.

Transferred to MEMBER Grade

Billings, Henry Chesbro, B.S. in Ae.E.; Capt., Project Engineer, U.S. Army Air Forces.

Cawl, Melvin Allen, Flight Control, Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Chalwin, Vivian James, Aircraft Repair Manager, Brush Electrical Engineering Co. Ltd. (England).

Cole, Russell Hammond, Design Engineer, Aviation Gas Turbine Div., Westinghouse Electric Corp.

Cregier, John Edward, Jr., General Sales Mgr., Commonwealth Aircraft Corp.

Eichhorn, Walter, Jr., Director of Operations, Allied Engineering Corp.

Graham, Richard Pope, B.Ae.E.; Weight Research Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Graham, William Henry, Jr., M.A., Major—Chief of the Civil Air Economy Div., U.S. Army Air Forces—Headquarters China Theater.

Henry-Felleman, Paul, Owner, The Paul Henry Co., Pacific Coast Field Engineer, Leach Relay Company.

Jensen, Harry Thomas, B.S. in E.E.; Chief Test Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Knecht, Robert Sidney, Ae.E.; Special Technical Asst. to Head of the Structural Modification Section, Bureau of Aeronautics, U.S. Navy Dept.

Knerr, Lewis Ellsworth, Jr., B.S. in M.E.; Staff Engineer, Pan American Airways System.

Kottke, Harry Garon, B.S. in Ae.E.; Administrative Engineer, Goodyear Aircraft Corp.

Light, Gordon Snavely, B.S. in M.E.; Lt. (j.g.), Asst. Assembly and Repair Officer, U.S.N.R.

Neighbours, James Willis, B.S. in M.E.; Lt., Aerological Officer, U.S. Navy.

Nesbitt, Marshall, B.S. in Ae.E.; Aerodynamicist, Douglas Aircraft Co., Inc.

Post, John E. H., B.S. in M.E.; Structures Project Engineer, Republic Aviation Corp.

Rhoads, Waldon Rice, B.A. in Physics; Project Engineer, Lockheed Aircraft Corp.

Robb, Alexander Forbes, B.Ae.E.; Engineer—Aerodynamics (Wind Tunnel Tests), Grumman Aircraft Engineering Corp.

Schmidt, Carl, M.Ae.E.; Flight Test Engineer, Lockheed Aircraft Corp.

Sheets, Jack Harold, M.S.E. (Ae.E.); Chief Design Engineer, Propeller Div., Curtiss-Wright Corp.

Terry, Evan Carlos, Supervisor, Engineering Liaison, Ryan Aeronautical Co.

Vogel, William Franklin, C.E.; Consulting Engineer—Aircraft.

Transferred to Industrial Member Grade

McLarren, Robert, Managing Editor, Air Age Publications.

Elected to Technical Member Grade

Codola, Pasquale Camera, B.S.; Stress Analyst, Bell Aircraft Corp.

Lyons, Leonard Joseph, B.S. in M.E.; Project Engineer, Fleet Aircraft Ltd. (Canada).

Majeske, William Herman, Engineering Draftsman, P.F.C., Norseman Air Transport, U.S. Army Air Forces.

Tsien, Shou-Hua, B.S. in Ae.E.; Engineer, Consolidated Vultee Aircraft Corp.

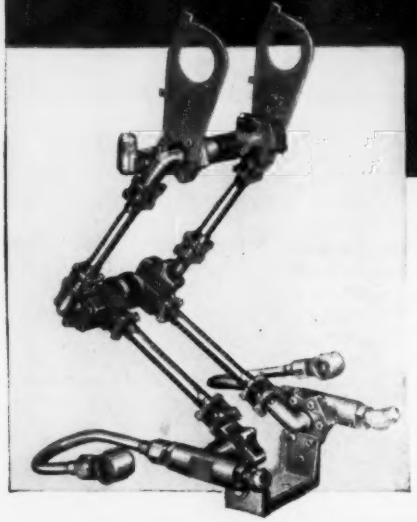
Venkataraman, Anantharama Sundaram, B.Sc.; Liaison Engineer, Hindustan Aircraft Ltd. (India).

Walker, Ivan Durman, Weight & Balance Engineer, Canadair Ltd. (Canada).

Transferred from Student to Technical Member

Broom, Marilyn Alys, B.S. in Ae.E.; Weights Group Div., Douglas Aircraft Co., Inc.

Crist, Lyle Martin, B.S. in Ae.E.



Natural flexibility is the secret of the eagle's soaring, swooping flight. *Mechanical flexibility* permits the maneuverability of present-day giant air liners. In such advanced ships as the Boeing Stratocruiser, Barco products are a vital factor in mechanical flexibility. Vital fluid-conveying pipes are protected against shock and vibration by Barco Flexible Joints. Brake mechanisms and hydraulic lines are also safeguarded by Barco design which counteracts sudden wrenches and impacts. For complete information about these products, write us now.

Ask about the Barco 3,000 pound swivel joint for aircraft cylinders and other applications.

BARCO FLEXIBLE JOINTS

Manufacturing Company, Not Inc., Aircraft Products Division, 1826 Winnemac Avenue, Chicago 40, Illinois

Not just a swivel joint . . . but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

"MOVE IN EVERY DIRECTION"

The Free Enterprise System is the Salvation of American Business

Eger, Robert Carl, B.S. in Ae.E.; Aerodynamic Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Hartman, Robert Bruce, President, Civil-Air Ferrying Echelon, Ltd.

Ing, Sheridan Chin-Fook, B.S.; Radio Technician, Trainee, U.S.N.R.

Kahr, Charles Horace, Jr., M.S. in Ae.E.; Research Engineer, Republic Aviation Corp.

Kelly, Sidney John, B.M.E.; Instructor, Dept. of Mech. Engineering, Bucknell Univ.

Lamberti, Nello A., B.S. in Engineering; Ensign, U.S. Navy.

Leydon, John Koebig, M.S., Ae.E.; Lt. Comdr., U.S. Navy.

May, Nelson Abels, B.S. in Ae.E.; Engineering Draftsman, Douglas Aircraft Co., Inc.

Merrill, Charles Thomas, B.S. in M.E.; Lt. Col., U.S. Army.

Miller, George Brown, Jr., B.S. in Ae.E.; U.S. Navy.

Nesbitt, Mason Whitney, B.S. in Ae.E.; Lt. Comdr., U.S.N.R.

Ormsby, Robert Benzein, B.S. in Ae.E.; Jr. Aerodynamicist, The Glenn L. Martin Co.

Spivack, Herman Melville, M.S.; Physicist (Aerodynamicist), National Bureau of Standards.

Zancanella, Frank Coolidge, B.S.

Necrology

Col. Porter Hartwell Adams

Col. Porter Hartwell Adams, an Associate Fellow of the Institute and James Jackson Cabot Professor of Air Traffic Regulation and Air Transportation at Norwich University, died at his home in Boston on December 5.

Born in Andover, Mass., on August 10, 1894, Dr. Porter was educated at the University of Redlands in California, the Massachusetts Institute of Technology, and Norwich University, from which he received the Degree of Honorary Master of Science in 1933 and Doctor of Science in 1935. In 1915 he was engaged as an engineer at the Cooper Aircraft Company and in 1916 worked on plans for the first proposed world flight. This flight was later made on a route similar to the one proposed by Dr. Adams.

He entered the Naval Aviation Corps in 1917 as an enlisted man and advanced to the rank of Lieutenant Commander. From 1919 to 1921 he was engaged in various engineering capacities, and in 1922 became Chairman of the Executive Committee of the National Aeronautics Association, assuming the presidency of this organization in 1926. He was Vice-President of the International Air Congress in Rome in 1927, Technical Adviser to the American Delegation at the International Civil Aeronautical Conference in Washington in 1928, and Chairman of the Aviation Medical Section at the First National Aeronautical Safety Conference in 1928.

In 1935, Dr. Adams became President of Norwich University in Vermont and served for 6 years until illness forced him to retire. During his administration at Norwich, the groundwork was laid for a large building and expansion program and he was instrumental in the establishment of the Cabot Foundation for the development of air transportation and regulation.

Lt. Woodward Burke

Lt. Woodward Burke, a Member of the Institute and Director of Flight Research at McDonnell Aircraft Corporation, was killed in an airplane accident during a test flight on November 1.

Born in Wilmington, Del., on March 20, 1914, Mr. Burke was educated at Purdue University, from which he received the degree of Bachelor of Science in Mechanical Engineering in 1935. Immediately after graduation, he enlisted in the Navy, taking his flight training at Pensacola, Fla. After receiving his commission, he remained on active duty with carrier-based fighter and dive-bomber squadrons at sea until 1939, when he was given inactive status. In that year, he joined Brewster Aeronautical Corporation as Chief Test Pilot. In 1944, he entered the McDonnell organization. He retained his commission as Lieutenant in the U.S. Naval Reserve.

John Joseph Gilmore

John Joseph Gilmore, a Member of the Institute and Superintendent of Maintenance, Transport Command, Royal Air Force, lost his life in an airplane accident at Prince Edward Island on May 1. News of his passing has only recently reached the Institute.

Born in Belfast, Ireland, on June 22, 1900, Mr. Gilmore was educated at Down Patrick Technical College in County Down, Ireland. From 1929 to 1933, he was a civil engineer with the Irish Free State Army Air Force, and from 1933 to 1940 he was an aircraft engineer with Imperial Airways, England. He began his work with the Royal Air Force in 1940.

Mr. Gilmore was credited in 1933 with being the first man to make a parachute jump over Irish soil.

Capt. William John Kossler

Capt. William John Kossler, U.S. Coast Guard, a Member of the Institute, died on November 16 in Bethesda Naval Hospital in Washington.

A native of Pittsburgh, where he was born on November 27, 1896, Captain Kossler attended Carnegie Institute of Technology and the U.S. Coast Guard Academy. He served with the Coast Guard in the first World War. After resigning in 1919, he re-entered the service in 1921 as an ensign. Until 1929, he was engineering instructor at the Coast Guard Academy, and in 1935 became Commanding Officer of the Coast Guard Air Station at Charleston, S.C. From 1940 to 1944, Captain Kossler worked on the development of the helicopter at the Coast Guard Air Station in Brooklyn. At the time of his death, he was on leave as Chief of the Coast Guard's Aeronautical Engineering Division.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Detail and Layout Engineers, Stress Analysts, Aerodynamicists, and Design Engineers—for development work and production engineering work in engineering division. Write for application blank to Chief Administrative Engineer, Boeing Airplane Company, Wichita, Kan.

Chief of Aerodynamics—To assume full responsibility for department of five to eight engineers. Must have a degree in aeronautical engineering with ten years' experience in aircraft work, five years of which must be in aerodynamics. Write for application blank to Chief Administrative Engineer, Boeing Airplane Company, Wichita, Kan.

Design Engineers; Draftsmen—Opportunities now exist for qualified design engineers and draftsmen for work on the new stratocruiser C-97 military transport and other new developments. Here is an opportunity to become associated with one of the world's leaders in aircraft design and production and to participate in the design of the aircraft of tomorrow. Address inquiries to Harold Mansfield, Public Relations Manager, Boeing Aircraft Company, Seattle, Wash.

Aerodynamicists and Thermodynamicists—Research minded and with good theoretical background, to engage in research work on high-speed and jet propulsion developments, advanced degrees preferred. Salary commensurate to qualifications. Replies will be held in strict confidence. Write, giving education and experience, to Curtiss-Wright Corporation, Research Laboratory, Buffalo, N.Y.

Aeronautical Engineering Professor to teach Airplane Design, Airplane Structure, and related subjects. Ap-

You name it we'll mold it in RUBBER!

Acct: PRATT & WHITNEY AIRCRAFT DIVISION

Case History #453

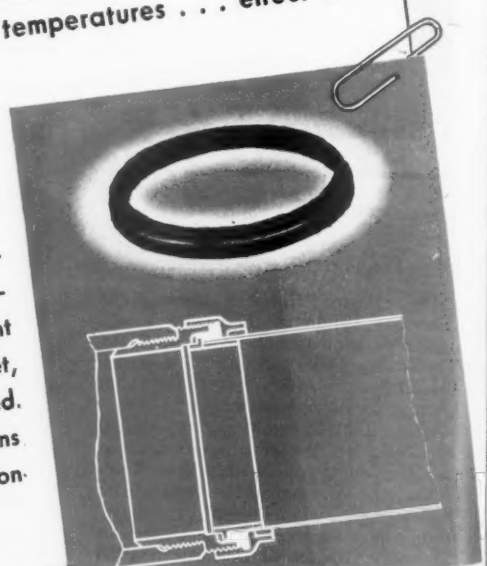
PROBLEM:

To find satisfactory leak-proof packing for ends of Intake Pipe on aircraft engine.

Existing rings permit leakage. Dirty to handle. Skived ends increase assembly cost. Not available in sufficient quantity. Replacement must be highly resistant to gasoline, oil and heat . . . seat to close tolerance . . . maintain dimensional stability under extreme temperatures . . . effect a sustaining perfect, leak-proof union.

SOLUTION:

Developed special design packing, precision-molded from Hycar oil-resistant synthetic rubber. Results of extensive testing under conditions far beyond ordinary demands:—excellent heat resistance, high modulus, good permanent set, perfect performance. Overall assembly cost lowered. Produced in great quantities exact to specifications. All tests proved in actual operation under all conditions. Seal is now a standard part.



The solution to this problem is typical of the hundreds of assembly parts "bugs" we have been privileged to study and overcome for American industry. Perhaps it parallels a problem which confronts you, or suggests a remedy for other product parts difficulties. In either case, Acushnet's accumulated technical experience, engineering skill, unsurpassed laboratory and production facilities (which won five "E" awards during the war) are available for research, recommendations and prompt action. Send complete details of your problem, or requirements for the improvement of your product. We'll gladly make recommendations for the most efficient and economical solution.

Acushnet PROCESS CO.
New Bedford, Mass., U.S.A.
Precision-Molded RUBBER Parts & Products

plicants required to have a degree in aeronautical engineering as well as practical experience in the field. Preference given to candidates having advanced degrees. Facilities now under construction and plans for future construction will provide ample opportunity for research, development, and consultation. Rank and salary will depend upon training and experience of applicant. In applying please give brief sketch of personal qualifications, education, and experience. Address reply to Prof. Robert M. Pinkerton, Department of Aeronautical Engineering, A. & M. College of Texas, College Station, Texas.

Aerodynamicists, Stress Analysts, Design Engineers, Detail, and Layout Draftsmen needed for development work on new experimental Military and Commercial model airplanes as well as other related projects of a "Confidential" nature. Curtiss-Wright has several excellent opportunities for qualified personnel. Address inquiries to Curtiss-Wright Corp., Airplane Division, Buffalo, N.Y., Attention: G. A. Page, Director of Engineering.

Aircraft Engineers—Immediate, permanent openings for aircraft engineers with 5 years' experience in aerodynamics, structural design, and C.A.A. airworthiness requirements with Southern California aircraft manufacturer. Air-mail qualifications and recent photo to P.O. Box 29, Burbank, Calif.

Detail and Layout Engineers, Stress Analysts, Aerodynamicists, and Design Engineers—For development work and production engineering work in Engineering Division. Call in person or write to Chief Administrative Engineer, Boeing Airplane Company, Wichita, Kan.

Radio, Electronic and Telephone Engineers, Electronic and Mechanical Draftsmen—One of the largest manufacturers of a wide variety of electronic and communications equipment in the world is fully prepared and ready with an ambitious postwar program. Write to Personnel Manager, Federal Telephone & Radio Corp., 591 Broad Street, Newark, N.J.

Aeronautical Engineer—To teach Senior year subjects of aeronautical engineering course including design and stress analysis. Address inquiries to The Aeronautical University, Inc., 116 South Michigan Avenue, Chicago, Ill.

Aircraft Stress Engineers thoroughly familiar with the analysis of aircraft structures, aircraft controls, and all component parts for work on helicopters. Excellent opportunities for personnel interested in rotary-wing aircraft. Apply by letter, giving references, to Administrative Engineer, Kellett Aircraft Corporation, Plant #2, Lansdowne Avenue above State Road, Upper Darby, Pa.

Personnel Needed—Executive and Administrative experience in manufacture of aircraft. Positions available in several fields; Factory and Production Management, Matériel, Tooling and Engineering. McDonnell Aircraft Corporation, Ambassador Building, St. Louis 1, Mo.

Aeronautical Engineers—for immediate work, the long-established Aeronca Aircraft Corporation seeks project engineers, design engineers, weight engineers, and layout draftsmen. These positions offer unusual permanent opportunities with the pioneer light-plane company of America for qualified men. Write in complete detail to Aeronca Aircraft Corporation, Box 00, Middletown, Ohio.

Assistant Professor—To conduct senior and graduate courses, develop laboratory, and direct research in aircraft power plants, with emphasis on standard aircraft engines and accessories. Advanced degree preferred. Position with an established aeronautical engineering department of a large eastern university. Appointment September, 1946. Salary open. Address inquiries to Box 434, Institute of the Aeronautical Sciences.

Aircraft Layout Draftsmen—Familiar with layout and design of aircraft sheet metal structures, controls, mechanisms, power plant, electrical systems and equipment. Excellent opportunities for experienced personnel interested in helicopter design. Address inquiries to Box 414, Institute of the Aeronautical Sciences.

Assistant or Associate Professor—To conduct undergraduate and graduate work in theory, design, and research in propellers and jet and rocket propulsion systems. Applicant should have at least one graduate degree and a sound theoretic and applied background in the thermodynamics and aerodynamics of propulsion systems. Large Midwestern University. Address inquiries to Box 413, Institute of the Aeronautical Sciences.

General Manager—A medium-sized aircraft company has opening for man qualified to direct manufacturing, sales, quality, personnel, accounting, and engineering functions. Must have long experience in management and good education. Company working on Government contracts, commercial aircraft production, and other manufacturing. Address inquiries to Box 410, Institute of the Aeronautical Sciences.

Research Fellows—To work half time on industrial research programs and study half time for M.S. or Ph.D. degree. Salary $1080 for 12 months together with freedom from tuition fees. Extra compensation during summer months may be obtained by working full time. Address inquiries to Box 398, Institute of the Aeronautical Sciences.

Research Engineer—To work on industrial research program. Electrical, mechanical, or civil engineering degree and some experience in materials-testing and vibration theory desirable. Salary $2600 or more depending on experience. Address inquiries to Box 397, Institute of the Aeronautical Sciences.

Engineer of Tests—To take charge of commercial and industrial structures and materials tests. M.S. degree and laboratory experience desirable. Opportunity to work for doctorate. Salary $3000 or more for 12 months depending on experience. One month vacation with pay. Address inquiries to Box 396, Institute of the Aeronautical Sciences.

Project Engineer—Experienced and talented design man to undertake the responsibility for a new aircraft project from inception to completion. Plant located on eastern seaboard. Salary scale above average. Write full particulars. Address inquiries to Box 370, Institute of the Aeronautical Sciences.

Works Manager—Manufacturing executive to set up and operate a production program on a new aircraft. Will direct Manufacturing, Facilities, Inspection and Procurement Departments. Salary scale above average. Located on eastern seaboard. Write full particulars. Address inquiries to Box 369, Institute of the Aeronautical Sciences.

Airplane Salesmen—Large established producer of personal aircraft seeking several qualified airplane salesmen with both flying and merchandising experience. Interview in New York. Address inquiries to Box 362, Institute of the Aeronautical Sciences.

Assistant Sales Manager—Large established producer of personal aircraft seeking qualified assistant sales manager. Interview in New York. Salary commensurate with ability. All replies treated confidentially. Address inquiries to Box 361, Institute of the Aeronautical Sciences.

Associate Professor of Aircraft Structures—To teach senior and graduate courses in aircraft structural theory, develop structures laboratory, and direct graduate structural research work. Practical experience necessary. Advanced degrees preferred. Permanent position. Leading State University. Location—Midwest. Address inquiries to Box 340, Institute of the Aeronautical Sciences.

Associate or Full Professor: To teach advanced courses and direct research in the Aircraft Power Plant Design field. Recent experience in turbine and jet engine design and testing necessary. Advanced degrees preferred. Permanent position, large mid-western university. Can wait six months if necessary. Address inquiries to Box 339, Institute of the Aeronautical Sciences.

Assistant or Associate Professor of Aerodynamics—Young man with Ph.D. to teach graduate courses in theoretical aerodynamics and direct theoretical and experimental research in this field. Research experience necessary. Position permanent. Mid-western State University. Address inquiries to Box 338, Institute of the Aeronautical Sciences.

Associate or Professor of Aerodynamics—To teach performance, control, stability and develop correlating flight test and flight instrumentation courses for large mid-western university. Position permanent. Practical experience necessary. Advanced degrees preferred. Address inquiries to Box 337, Institute of the Aeronautical Sciences.

Patent Engineer—Familiar with patent disclosures and procedures. Essential helicopter industry. Salary commensurate with experience and present earning capacity. Address inquiries to Box 322, Institute of the Aeronautical Sciences.

Assistant Professor—To teach Mechanics, Strength of Materials, and Physics in a small Mid-western College. Must have Master of Science Degree, preferably in Engineering or Physics. Salary dependent on qualifications and experience. Position permanent. Address inquiries to Box 291, Institute of the Aeronautical Sciences.

AVAILABLE

Aeronautical Engineer—Fourteen years actively engaged in the aircraft industry, including project design, flight test, and development engineering, and as representative in procurement and field service. Thorough knowledge of maintenance and flight operation, including A. and E. licenses and 7 years' flight experience. Present affiliation with major aircraft company, entered in 1937. Desires permanent responsible position and opportunity for advancement, commensurate with ability, in development, sales, or as technical representative. Geographical location unimportant. Four years of university work and graduate of two leading schools of aeronautics. Understands Spanish and French. Excellent commercial and military references. Address inquiries to Box 436, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.Ae.E., University of Minnesota. One year detail design and minor layout drafting. Over four years' service with Air Technical Service Command, U.S.-A.A.F., as engineering officer. Military experience included one year of checking contractor-submitted stress analyses and the design and supervision of installation, in aircraft, of experimental equipment; three years as resident liaison engineer for A.A.F. at large West Coast aircraft manufacturer. Served three months in England and Germany with Air Technical Intelligence Section of U.S. Strategic Air Forces as technical investigator of German aircraft development. Desires permanent position with opportunity for advancement in technical or administrative engineering or allied field. Los Angeles area preferred. Available now. Address inquiries to Box 435, Institute of the Aeronautical Sciences.

Engineering Draftsman—Four and one-half years' experience in aircraft work, 1 year, sheet metal layout; 6 months, tool design; 2 years, aircraft hydraulics; and 1 year, shop liaison. Three years of college. Desires position in Chicago area with organization offering future. Will consider position in other than aircraft industries, but aircraft industry preferred. Draft exempt. Excellent references available June 1. Address inquiries to Box 433, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Graduate work in Ae.E. Almost 6 years' experience in flight test, stability and control, and wind-tunnel testing on multiengined landplanes and seaplanes with large company. Desires stability and control or flight-test work with West Coast air line. Address inquiries to Box 432, Institute of the Aeronautical Sciences.

Engineer — Manufacturer — Eighteen years in aircraft industry. Experienced as Chief Engineer of large aircraft company during the war. Also experienced in operation of own company manufacturing subcontract aircraft parts. Desires position with small company having proprietary articles to engineer, manufacture, and sell. Have private pilots' license and fly own light airplane. Address inquiries to Box 431, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Officer R.C.A.F. Engineering education. Six years' aircraft maintenance, liaison inspection and engineering in manufacture and overhaul of military aircraft. Considerable technical administration work. Glider construction and design experience. Desires position whereby technical qualifications can be utilized and experience to a more advanced standing possible. Future opportunity is the prime requisite. Address inquiries to Box 430, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Five and one-half years' experience in Airline Engineering (Operation and Maintenance) and Aircraft Manufacturing. Two degrees in Aeronautical Engineering. Part time work desired. Address inquiries to Box 429, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.Ae.E. Two and one-half years' experience with a leading aircraft manufacturer as layout draftsman and preliminary stress analyst. Served with Marine Corps Aviation as Commanding Officer of service squadrons, Group Engineering Officer, at present Production Superintendent of overhaul activity. Nearly five years of active duty in U.S. and overseas. Desires to become connected with engineering staff or air line for maintenance, overhaul work, or allied subjects.

Engineer—World War II veteran, engineering degree. Eight years' flying experience in U.S. Navy, 4 years service engineering, 2 years test-pilot and development work. Qualified in various types service planes including single and multi-engine, both land and sea. Recent experience in jet-propelled aircraft. Desires opportunity to do research and development work including flying. No objection to traveling. Excellent references. Address inquiries to Box 427, Institute of the Aeronautical Sciences.

Air Passenger Research—College graduate, experienced. Available temporary or permanent. Address inquiries to Box 426, Institute of the Aeronautical Sciences.

Chief Engineer, Mechanical, Development and Research—Wide experience, automotive and aeronautical, ball and roller bearings and all applications, gears, landing gear; initiated current propeller; mature judgment, capacity for detail, executive experience. Ability to analyze new design, foresee possibilities, and carry from start to production drawings. Now have paying consulting business but prefer direct responsibility. Address inquiries to Box 425, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in General Engineering from Georgia Tech. 24 years of age. Three years' experience in dynamic stability research; duties included design of wind-tunnel models and some maintenance and wind-tunnel operation. The last 6 months have been spent in development and flight tests of rocket-propelled missiles. Desires position as aerodynamicist or flight test engineer, preferably on development of new design. Excellent references. Address inquiries to Box 424, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Graduate with eighteen years of practical experience in aircraft design and engineering with emphasis on aerodynamics, wind-tunnel testing, flight-testing, power plants and weights control. Desires a supervisory position in connection with aircraft design and development engineering or flight test. Address inquiries to Box 423, Institute of the Aeronautical Sciences.

Aeronautical Engineers—Recently incorporated organization of experi-

enced engineers is interested in designing a complete airplane or any of its parts. Aerodynamic, structural, and power-plant installation problems capably executed. Complete responsibility will be assumed for obtaining C.A.A. approval. The diversified background of our engineering staff in designing for production assures a product which not only incorporates sound engineering, but also can be manufactured economically. Address inquiries to Box 422, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.Ae.E. degree. Five and one-half years' experience in stress analysis and design of large aircraft structures with a large eastern concern. Familiar with all parts of the airplane. Part time spent as group leader. Mid-West location preferred. Would like airline work. Address inquiries to Box 410, Institute of the Aeronautical Sciences.

Engineer—One and one-half years' experience as structural test engineer and stress analyst with major aircraft company. M.E. graduate of Lowell Institute School, M.I.T. No objection to traveling. Address inquiries to Box 420, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in Ae.E. with approximately 12 years' experience in military and civil airplane engineering. Complete structural responsibility on recent Navy and Army fighter airplanes with large organization. Inventive ability and productive minded. Knowledge of loads, vibrations, and flight testing. Experienced in supervising large group. Desires a permanent and responsible design or stress position in progressive organization in East or Middle West where his experience and abilities can be fully utilized. Address inquiries to Box 419, Institute of the Aeronautical Sciences.

Aeronautical Engineer, Executive—B.Ae.E., age 33, Commander U.S.N.R., available shortly. Seven years' experience in design, development, modification, overhaul and maintenance of naval aircraft, both production and experimental types. Particularly strong on structures. Administrative experience. Desires responsible position where initiative and capabilities can be employed. No objection to traveling. Willing to locate anywhere. Will consider affiliation with progressive nonaircraft organization. Address inquiries to Box 418, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Bachelor's and Master's degrees in aeronautical engineering. Eight years' experience with Army, Navy, and commercial types covering all existing types of construction. Experienced in aerodynamics, structures, basic and detail design, and development and experimental work. Good knowledge of shop practices and thoroughly familiar with C.A.A. design requirements, including new CAR 03. Prefers work on small and medium-sized commercial aircraft. Any location considered. Address inquiries to Box 417, Institute of the Aeronautical Sciences.

Aeronautical Management Engineer—Registered professional aeronautical engineer with over 18 years' broad supervisory experience in aircraft engineering and production. Organization, Methods and Procedures, and Maintenance. Five years as Mechanical and Electrical Engineer. Will set up or improve organization, administrative and other control procedures, production and inspection methods and procedures, production and maintenance design; cut manufacturing, operating, and maintenance costs, initiate and maintain liaison with Government and industry for Air Line or Aircraft Manufacturer. Recently Chief, Maintenance Control and Chief, Methods and Procedures, for 2 years with U.S. Army Strategic Air Forces and Air Technical Service Command. Address inquiries to Box 416, Institute of the Aeronautical Sciences.

Executive Engineer—Graduate engineer with eight years' aircraft experience including production planning, cost estimating, master scheduling, and past five years senior design engineer. Prefers Mid-West location in aircraft or allied field. Address inquiries to Box 415, Institute of the Aeronautical Sciences.

Manufacturing Executive—Twenty years' experience, mostly aircraft, all phases manufacturing and procurement. Specialized in planning, material control, estimating, production control, procurement and production management. Available immediately. Address inquiries to Box 412, Institute of the Aeronautical Sciences.

Engineer—Wing structures specialist. Ten years' experience, seven in structural design, three in stress (including fuselage bending analysis as well as wing). In charge of structure for thin airfoil design nearing completion. Anxious to do more work in thin airfoils and assume more responsibility. Address inquiries to Box 411, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S.Ae.E., and C.A.A. Aircraft Mechanic Certificate. Experience consists of seven months in aircraft manufacture while attending college, and two years, since graduating from college, in maintenance and design engineering on four-engined transports for commercial airline. Interested in position with another air line, manufacturer's field service technical representative, or similar work. Any location considered. Address inquiries to Box 406, Institute of the Aeronautical Sciences.

Aeronautical Engineer (native Russian)—Would like to translate Russian scientific and technical papers. Thoroughly acquainted with the field of theoretical and applied aerodynamics. Address inquiries to Box 405, Institute of the Aeronautical Sciences.

Aeronautical and Mechanical Engineer—B.S., S.M. Broad experience in theoretical and experimental stress analysis, vibration theory, and instrumentation. Project organization and customer liaison work. Long residence in the Orient. Speaks and writes Russian fluently; some French and Chinese. Interested in responsible position with consulting firm or similar organization having foreign contacts. Address inquiries to Box 404, Institute of the Aeronautical Sciences.

Aeronautical Engineer—M.S. in Ae. and Me.E., 1924. Research, Preliminary design, Development. Past experience includes: Consulting Engineering (research, coordination of new developments); Project Engineer, Aerodynamicist, Research Engineer. High references. Prefers location in United States or Canada. Address inquiries to Box 402, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.A.E. One and one-half years' aeronautical research experience; plus 3 years' experience in structures, drafting, liaison, production expediting for large aircraft corporation. Desires design or production management position with aircraft manufacturer. Address inquiries to Box 401, Institute of the Aeronautical Sciences.

Development Engineer—Aeronautical engineering degree, industrial management training. Five years' experience in aircraft engine design and research aircraft production, editing. Ideal assistant for busy executive. Will conduct correspondence and technical writing, assist in project administration, planning and coordination, or handle strictly technical assignment. Address inquiries to Box 400, Institute of the Aeronautical Sciences.

Hydraulic Service Engineer—One year at Purdue University; one year at Indiana University Extension. Graduated from Aviation Mechanical School, Curtiss-Wright Tech., Glendale, Calif., with high scholastic honors. Approximately six years' experience in aircraft hydraulics as teacher, designer, mechanic, and school supervisor. Taught and supervised aircraft hydraulics at Curtiss-Wright Tech. Established, taught, and supervised aircraft hydraulics at Utah State College at Logan, Utah. During the past 3 years, while in the Navy, has been assigned to duty as hydraulic supervisor and established one of the largest aircraft hydraulic schools in the country. During these 3 years has also designed and constructed hydraulic valves, fittings, test benches, and

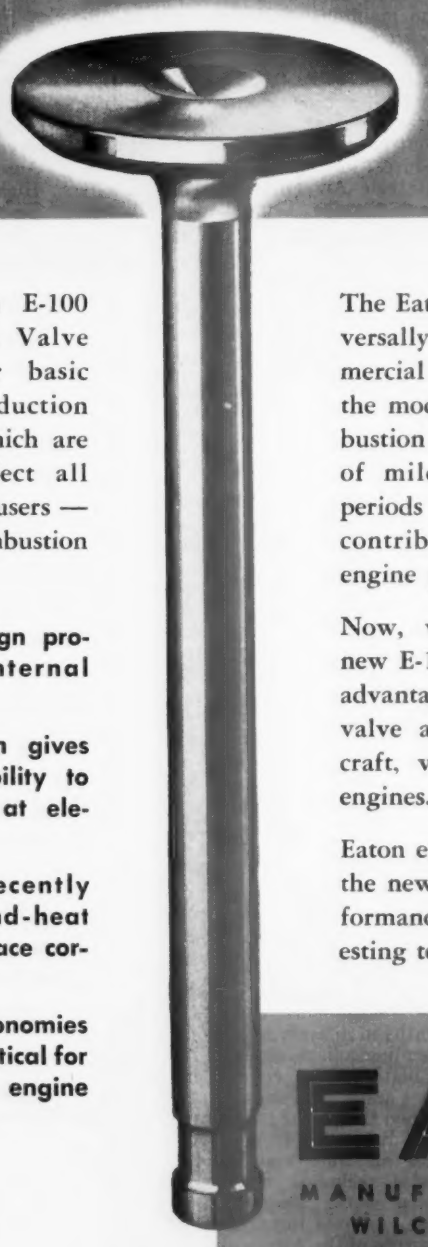
Eaton Presents a New Improved

Sodium Cooled Valve

That Brings the Advantages of the Internally Cooled Valve to All Internal Combustion Engines

The new Eaton E-100 Sodium Cooled Valve represents four basic design and production advancements which are destined to affect all builders — and users — of internal combustion engines:

1. **A new hollow-head design provides for improved internal cooling.**
2. **Unique head construction gives greater strength and ability to maintain normal shape at elevated temperatures.**
3. **The use of Eatonite—recently announced corrosion-and-heat resistant alloy—reduces face corrosion to a minimum.**
4. **Design and production economies make the E-100 valve practical for all internal combustion engine applications.**



The Eaton Sodium Cooled Valve—universally adopted for military and commercial aircraft use—has made possible the modern high output internal combustion engine. It has added thousands of miles to valve life, lengthened periods between valve servicing, and contributed to materially improved engine performance.

Now, with the introduction of the new E-100 valve, the many recognized advantages of the internally cooled valve are made available to all aircraft, vehicle, marine, and industrial engines.

Eaton engineers will be glad to discuss the new E-100 valve, and present performance data which will prove interesting to all engine builders.

EATON

MANUFACTURING COMPANY

WILCOX-RICH DIVISION

9771 FRENCH ROAD • DETROIT 13, MICHIGAN

mock-ups for Navy use. Possesses a C.A.A. airplane mechanic certificate. Mechanical background: welder, lathe operator, riveter, etc. Address inquiries to Box 399, Institute of the Aeronautical Sciences.

Test Pilot—B.S. in A.E., Oregon State College. Five years of Navy flying, including Instructor in single and multiengine aircraft: 1,000 hours four-engine time; 1,000 hours twin-engine time; 2,800 hours total. Thirteen months of Aleutian flying, Navy Maintenance Officer, Weight and Balance. Holds commercial, instrument, and radio licenses. Desires engineering test with foreign or domestic company. Address inquiries to Box 395, Institute of the Aeronautical Sciences.

Mechanical-Aeronautical Engineer—B.S. in M.E., University of Michigan. Seventeen years' experience with aircraft manufacturers, air lines, and aircraft maintenance equipment manufacturer. Designed and patented manufacturing and maintenance equipment now used extensively in the industry. Held responsible positions in development, design, sales and management. Broad general experience in most phases of the aeronautical industry throughout the United States. Desires executive position with an air line or allied industry manufacturing aircraft, aircraft equipment, or maintenance equipment for the air lines. At present is a naval officer on air-transport engineering duty. Expects to be released to inactive duty in January, 1946. Address inquiries to Box 394, Institute of the Aeronautical Sciences.

Aeronautical Engineer—University Michigan graduate with 20 years' design and executive experience, desires responsible position with aircraft manufacturing, aircraft accessory, or air-line organization. Experienced on Army, Navy, and C.A.A. Requirements. Address inquiries to Box 393, Institute of the Aeronautical Sciences.

Project Engineer—B.S. in M.E., Aero. E. Thirty-five years old. Over 10 years of aircraft design, structural layout and administrative duties. Seven and one-half years of supervisory experience in engineering, seeking executive or supervisory position, not necessarily in aviation. Location open. Address inquiries to Box 392, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. Aero Eng., New York University, 30 years old, married. Eight years' experience in design and design supervision as Group Leader and Assistant Project Engineer for various prime contractors of military aircraft. Complete and varied experience in all phases of aircraft design, including structural, power-plant installation, controls, armament, equipment, hydraulics, etc. Also shop experience, engineering shop contact, flight-test, and general administrative experience. Responsible position in any field considered. Location on East Coast preferred, but not essential. Address inquiries to Box 391, Institute of the Aeronautical Sciences.

Design Engineer—Available on fixed basis for specific designs of aeronautical, structural or mechanical nature. For detail qualifications address inquiries to Box 390, Institute of the Aeronautical Sciences.

Aeronautical Engineer and Pilot—Graduate Aeronautical Engineer with $2^1/_2$ years in Army Air Forces, including "Aircraft Maintenance Engineering" course at Yale University and A.A.F. pilot training. C.A.A. Commercial Pilot and Ground Instructor. Desires position with flying school or engineering division of air line. Willing to work in foreign country. Address inquiries to Box 389, Institute of the Aeronautical Sciences.

Aerodynamicist and Physicist—B.S. in E.E.; M.S. in Applied Physics; $1^1/_2$ years' Doctorate work in Applied Science. Seven years' teaching experience in university—Aerodynamics, Physics, Fluid Mechanics, and allied subjects including graduate level. Five years' experience as Aerodynamicist, Propeller Designer, and Stress Analyst. Prefers university position with research and consulting possibilities and a possibility of completing Doctorate, or responsible industrial position with good chances for advancement within commuting distance from approved graduate engineering or science college. Address inquiries to Box 388, Institute of the Aeronautical Sciences.

Technical Administration or Technical Sales—Over 20 years of aircraft experience which has covered airplane project design followed by ten years of technical administration work in the top management of two large airplane companies. Wishes responsible position in connection with technical sales. Address inquiries to Box 387, Institute of the Aeronautical Sciences.

Engineer–Executive—Twelve years' experience includes airplane design, stress analysis, and structures. Director of Aeronautical Engineering and Sales in aircraft accessories field. Wide acquaintance in the industry, including manufacturers, air lines, aircraft distributors, A.A.F., and Navy Bureau of Aeronautics. University graduate and professional aeronautical engineer. Seeks permanent connection as a key personnel in design, executive, or sales engineering, or as manager in the aviation department or technical adviser in nonaviation industry. Development and experimental work welcome. Address inquiries to Box 386, Institute of the Aeronautical Sciences.

Administrative Engineer—Graduate engineer with over 15 years' experience in design, research, and manufacturing. Eight years' experience in the administration of a division of engineering of a well known aircraft company. Desires a position of responsibility with a medium sized company that has good prospects for future advancement. Address inquiries to Box 385, Institute of the Aeronautical Sciences.

Engineer—B.S. in Aeronautical Engineering, licensed airplane mechanic, four years' experience. One year on aircraft design and development. Three years as research engineer on aircraft and other types of internal combustion engines. Chinese with good knowledge of language. Desires a responsible position in China in engineering, engineering sales, or as a technical representative in the aviation, oil, or automotive industry. Excellent references. Address inquiries to Box 384, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in Ae.E. (Mexican Citizen); speaks and writes Spanish. Desires position with a small company with good opportunities for advancement. Any location in the United States would be considered. Would also consider a position in Mexico as a representative of a company with business relations in this country. Address inquiries to Box 383, Institute of the Aeronautical Sciences.

Structures Engineer—B.S. in Aero. Engineering. Five and one-half years stress experience with the Development Engineering Department of a large Aircraft Corp. Desires responsible position in the Los Angeles area. Address inquiries to Box 382, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Ae.E. Two years' experience as Foreman in Charge of Spinning Aircraft Fabrics, two years in Hydraulics and Contact Work, three-and-one-half years as Design Engineer in Aircraft Turret Work, including Design and Layout Work in Armament. Desires position as Sales Engineer or Project Development work. West Coast or Midwest location preferred. Will accept work in Foreign Country. No objection to traveling. Available immediately. Address inquiries to Box 381, Institute of the Aeronautical Sciences.

Aeronautical Engineer—with own design of helicopter having two coaxially counterrotating lift rotors seeks connection with Aircraft Manufacturer. Thirty years' total professional experience including 15 years' airplane, and 2 years' helicopter design and development. Address inquiries to Box 380, Institute of the Aeronautical Sciences.

Electrical Engineer—B.S. in E.E., M.S. in E.E., four years' experience coordinating research and develop-

ment programs aircraft electrical systems. Ten years' design and manufacture electrical equipment. Desires technical administrative position with electrical manufacturer specializing in aircraft. Address inquiries to Box 379, Institute of the Aeronautical Sciences.

Quality Control Manager, Chief Inspector—Eighteen years' aircraft experience. Excellent references. Army or Navy work preferred. Location East Coast. Address inquiries to Box 378, Institute of the Aeronautical Sciences.

Mechanical and Aeronautical Engineer—B.S. in M.E., Aeronautical Engineering Option, 1936. Candidate for M.S. degree in Mechanical Engineering with graduate work to be completed during first year after release from active duty. Two years' experience Machine Tool Design and Drafting; three and one-half years' experience in Aircraft Propeller Design and Vibration Research; one-half year experience in Aeronautical Research; thirty-nine months' service as officer in Army Air Forces Air Technical Service Command's Engineering Division Laboratories and Central District as Project Officer. Highest references. Location near New York City preferred. Address inquiries to Box 376, Institute of the Aeronautical Sciences.

Development Engineer—Graduate Engineer, B.S. in Ae.E., with 6½ years of aircraft and machine design experience, including design of and fabrication contact for varied mechanisms, landing gears, and hydraulic units. Location in Eastern district preferred. Particularly interested in smaller company with expanding post-war plans, in which advancement is possible along with the company. Address inquiries to Box 375, Institute of the Aeronautical Sciences.

Stress Analyst, Design and Development Engineer—B.S. in aeronautical engineering; five years' experience in aeronautical engineering after graduation. Structural design and analysis experience with large manufacturer of military landplanes and seaplanes. More than two years' work in the investigation and development of new structural materials and types of construction including magnesium, plastics, sandwich construction. Experience in latest structural test methods; one-and-a-half years' experience as design project officer in Bureau of Aeronautics with engineering cognizance over production and experimental models. Desires permanent position as assistant design project engineer or as structures analytical or test engineer with East or West coast manufacturer. Address inquiries to Box 374, Institute of the Aeronautical Sciences.

Engineer, Development or Chief—Over 25 years on airplane design, accessories development, operations engineering, technical writing, and executive work. Wide experience with all types of materials; inventive and possessing initiative. Recent salary $7,500, but will consider proposition. Eastern part of U.S. preferred but not essential. Address inquiries to Box 372, Institute of the Aeronautical Sciences.

Jet Propulsion Engineer—M.E., M.S. Worked with rockets several years before Pearl Harbor. Asst. Director of Research of O.S.R.D. laboratory where bazooka was developed. Desires contact arms, airplane, or engine manufacturers, and others interested in setting up an independent jet propulsion research laboratory for developing rockets, jets, athodyds. Address inquiries to Box 371, Institute of the Aeronautical Sciences.

Director of Flight Training—Ranking Naval Officer available soon, desires position as Director of Flight Training Program for progressive University. Ten years' teaching, 24 years' aviation. Mechanics, Flight, and Ground Instructor ratings. Organization and operating experience. Address inquiries to Box 368, Institute of the Aeronautical Sciences.

Air-Line Service Engineer—B.S. in Aero. Eng. Over five years with major air line specializing in service problems on some trainers and most types of air transport aircraft. Experienced in troubleshooting, establishing service procedures, etc. Has supervised engineering projects. Desires similar position with small air line or aircraft manufacturer. Address inquiries to Box 367, Institute of the Aeronautical Sciences.

Aeronautical and Structural Engineers—Recently formed engineering organization is interested in contacting aircraft manufacturers in southern California for engineering of entire airplanes or major components. Will assume full responsibility for stress analyses and C.A.A. negotiations. All members of this group have held responsible aeronautical engineering positions in both small and large companies during the last 10 years. Address inquiries to Box 366, Institute of the Aeronautical Sciences.

Gear Expert and Mechanical Engineer—Also has considerable aeronautical experience. Fine leadership qualities coupled with analytical mind. M.I.T. graduate. Age 31. Desires responsible position with consulting firm or other organization. Address inquiries to Box 365, Institute of the Aeronautical Sciences.

Administrative Engineer—B.S. in A.E. from University of Michigan. Graduate of Civilian Pilot Training and possesses civilian pilot's license. Also holds an Aircraft Mechanic Certificate. Graduate of an accelerated course in Maintenance Engineering at Yale University. At present Administrative Officer assigned to an Aircraft Maintenance Unit, A.A.F. Would prefer employment by a commercial air line. Will be available within the next four months. Address inquiries to Box 364, Institute of the Aeronautical Sciences.

Engineer—Aeronautical Graduate. Familiar with research of transport aircraft and technical writing. Manufacturing and air-line experience, maintenance and operations. Administrative, writing, and sales ability. Desires position in engineering sales writing or as a technical consultant for aviation or nonaviation industry. Address inquiries to Box 363, Institute of the Aeronautical Sciences.

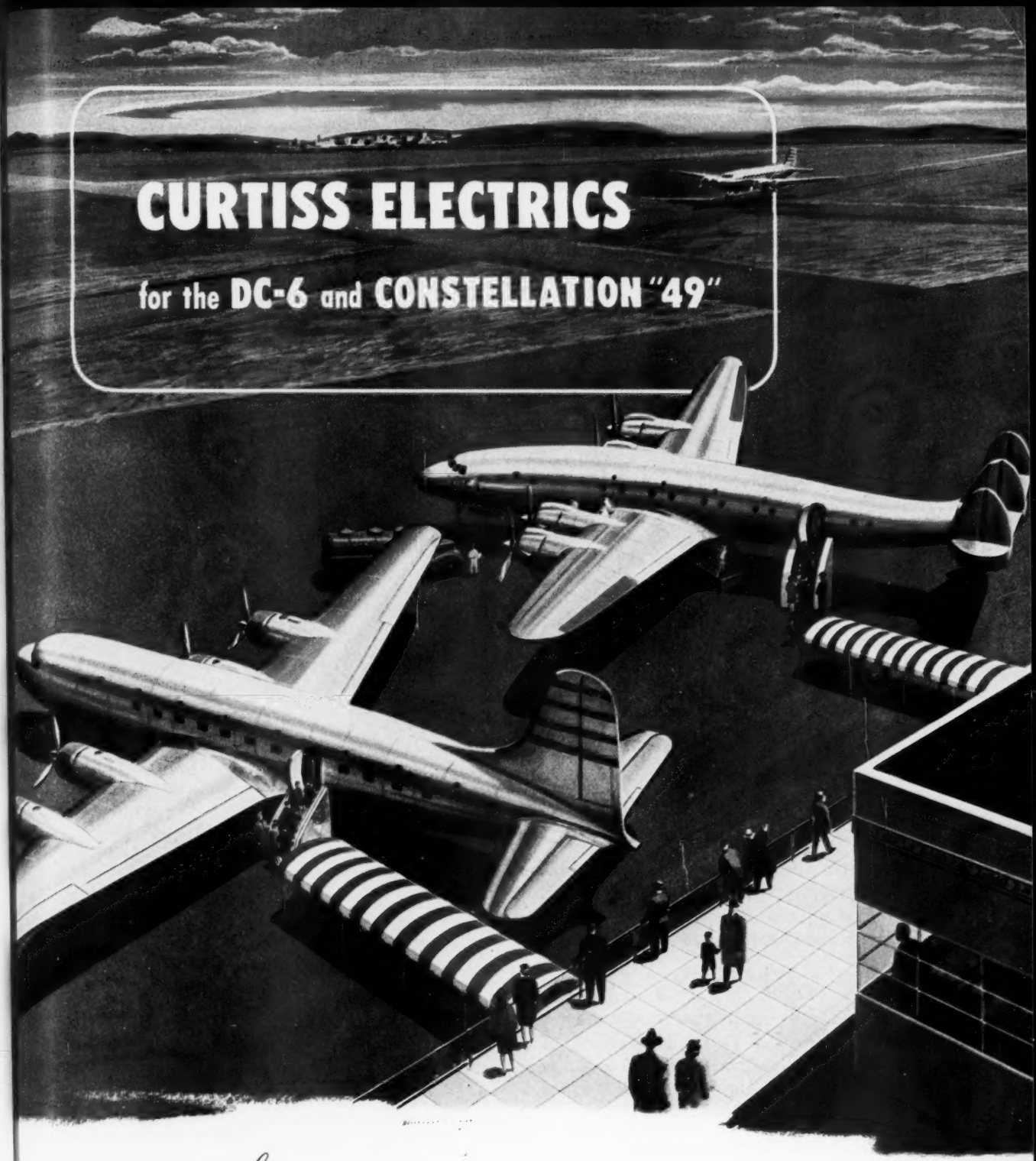
Aeronautical Engineer—Ten years' experience teaching aeronautics and allied subjects. At present employed by Navy Department in aerodynamic analyses of military aircraft, including considerable work in jet propelled types. Desires a teaching position in the south or southwest by winter or spring term. Address inquiries to Box 358, Institute of the Aeronautical Sciences.

Engineering Service and Sales Representative—Engineering Degree, total of 10 years' aircraft design, accessory and sales engineering, hydraulic and control equipment experience. Extensive contacts, services, aircraft plants, industrial and marine field. Seeking position in engineering or engineering sales or as technical representative in aviation or allied field. Address inquiries to Box 357, Institute of the Aeronautical Sciences.

Aeronautical Equipment and Sales Engineer—Graduate engineer with 14 years' experience in civil and military aviation specializing in the sales and service of aircraft instruments and equipment. Recently released from active service in the Army Air Forces after 6 years devoted largely to pilot training and aircraft and equipment testing. Over 5,000 hours as pilot in military and civil aircraft. Interested in position offering executive responsibilities in the interest of sales and service within this country or abroad. Will consider any position where a broad background in aviation development, initiative, responsibility can be employed. Available for immediate employment. Excellent references. Address inquiries to Box 356, Institute of the Aeronautical Sciences.

Design Specialist—B.S.Ae.E. Ten years' experience private pilot, experimental engine testing, stress analysis, preliminary airplane design, contract administration, responsible for the design and manufacture of numerous engine installations ranging from 165 to 3,000 hp., as well as turbo and turbojets. Excellent background in coordination of production and tooling acquired in capacities of project engineer and design section manager. Widely acquainted in the industry east and west.

(Continued on page 113)



the Scene is any large airline terminal. The aircraft are the new Douglas DC-6 and the Lockheed Constellation "49"—bringing to the commercial airlines new standards in passenger comfort—featuring the Curtiss Automatic Synchronizer for quieter, simplified engine control and Curtiss Aerodynamic Braking by reverse thrust for shorter, smoother landings.

CURTISS ELECTRIC PROPELLERS

A Division of Curtiss-Wright Corporation

"TRANSFAX laid out all these parts on one plate . . . *in only 8 minutes!*"

Let Transfax put your drawings directly on metal, plastics, rubber... along with precise instructions for cutting, drilling, or welding

In operations of from a few to several thousand industrial units, the Kodak TRANSFAX PROCESS wins approval for speeding production . . . makes previously unheard-of savings in time and labor . . .

With line-for-line accuracy, Transfax puts the original drawings from your Engineering Department directly on the metal, plywood, plastics, or rubber . . . ends laborious scribing . . . ends costly, time-consuming errors.

Where layouts and templates are complex . . . where instructions as well as dimensions should be on every piece to be fabricated . . . where accurate lines and points are needed to guide the welder or the man at the drill-press or cutting machine . . . the value of Transfax goes unchallenged. And Transfax withstands rough handling. Even the cutting torch won't erase it except by direct contact.

Transfax is surprisingly simple to install. No special equipment is needed. No special training of workers. In any ordinary room—using a spray gun, a watering hose, and an arc or mercury vapor lamp, Transfax gets big, 8-foot plates ready for fabrication *in 8 minutes!*

For full information on this revolutionary, new Transfax Process, clip and mail the coupon *today*. Now is the time to begin taking advantage of the economies of Transfax.

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

TRANSFAX

SAVES TIME • ENDS ERROR
SPEEDS PRODUCTION

FREE FOLDER—
CLIP COUPON

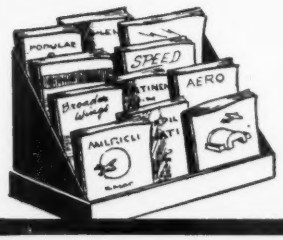
Gentlemen: I want to know more about TRANSFAX, its many applications and economies. Please send my copy of the folder to:

NAME_____

STREET_____

CITY_____ ZONE_____ STATE_____

Kodak



Periodicals

Accessories and Equipment

Retardation Efficiency of Shock-Absorber and Arrester Gear. P. B. Walker. It is stated that the complexity of much of the mechanical gear used for shock absorption and arresting in aircraft engineering is apt to obscure some of the broad generalizations that may be deduced from the elementary principles of classical mechanics. More particularly this applies to the distance required to arrest the motion of an aircraft or falling body when the retarding force must not exceed a specified value. The writer states some more or less self-evident truths that may be of value in dealing with new landing and arrester problems. He discusses the fundamental principles connected with deceleration as applied to landing gear, horizontal arrester gear, the free dropping of supplies and equipment, and dropping by parachute. *The Journal of The Royal Aeronautical Society*, October, 1945, pages 652–657, 2 illus.

Electrical Ignition for Aircraft Internal-Combustion Heaters. E. H. Plesset, J. D. McCrumm, M. S. Plesset, and T. N. Floyd. Details are given about research work carried out by the Douglas Aircraft Company to overcome difficulties encountered with the ignition system of internal-combustion heaters. The work was directed toward improving ignition and operation on a "quick-fix" basis. Requirements were that the "quick fix" should not necessitate basic alteration of current heater installations; ignition should be possible under extreme environmental conditions; and the normal period between service checks should be greater than 50 hours of heater operation. Particulars are given about the ignition system that was developed. *Mechanical Engineering*, November, 1945, pages 715–722, 14 illus.

Aerodynamics

High-Lift Devices and Tailless Aeroplanes. A. R. Weyl. Continuing a discussion of problems connected with the design of tailless aircraft, the writer investigates devices installed on a wing to secure greater values of maximum lift. The aerodynamic characteristics of unassisted and assisted devices of this kind are examined. Sections are allocated to the disrupter as a high-lift device; slots; plain, split, and extension flaps; external airfoil flaps; and assisted ("nonatmospheric") high-lift devices. *Aircraft Engineering*, October, 1945, pages 292–297, 19 illus.

Estimation of Static Longitudinal Stability. E. J. N. Archbold. The writer discusses the static longitudinal stability of an aircraft in the simple case when the aerodynamic derivatives are independent of speed. An outline of the basic theory of static stability is given, accompanied by a working document, giving suitable forms for the estimation of neutral points from wind-tunnel tests. A worked example is included for a typical case. No attempt is made to interpret the results but the conclusions include a note on the center-of-gravity margin. Loss of stability "stick free" and scale effect are commented on briefly in an appendix. *The Journal of The Royal Aeronautical Society*, October, 1945, pages 616–638, 9 illus.

Airfoil Development and Structure within the Camber Surface. Part I. Roy A. Liming. One of the two writers of the serial article "Lofting Problems of Streamline Bodies" is contributing a new series intended to explore further the possibilities of mathematical analysis of the aerodynamic structure of an airplane. Part I of the new series is divided into three sections, of which the first presents the advantages inherent in the system of algebraic and trigonometric calculations resulting in maximum accuracy and speed in the production of the desired dimensional data. It is shown that, while a graphic solution will provide an approximate answer for a given problem, the mathematical solution gives an exact answer. The method is also useful in checking the accuracy of a graphic layout, to supplement the layout as a source of dimensional information, or to replace the layout entirely. For speed the use of analytic geometry has great advantages in lessening tedious calculations because automatic electric calculating machines can be employed for high-speed reduction of algebraic expressions. It also aids in securing uniformity through the establishment of standardized short-cut methods and formulas for solving typical problems in design, lofting, and tooling, as well as assuring simplicity of procedure.

The second section of Part I explains the application of a system of analytic calculation techniques to the cambered surface of the airplane and its internal structure, requiring the establishment of appropriate sets of coordinate reference lines or axes. An outline is suggested for a typical subassembly "breakdown" of the airplane

INDEX

Accessories and Equipment.... 51
Aerodynamics..... 51
Air Cargo..... 53
Air Policy..... 53
Air Power..... 53
Air Transport..... 53
Airplane Descriptions..... 55
Airports and Airfields..... 57
Avigation..... 57
Business and Finance..... 58
Civil Aviation..... 58
Control Equipment..... 58
Deicing..... 59
Design..... 59
Electrical Equipment..... 61
Engines..... 61
Flight Technique..... 63
Fuels..... 65
Gliding and Soaring..... 65
Hydraulic Equipment..... 65
Inspection..... 65
Instruments..... 65
Lubrication..... 66
Maintenance..... 66
Marketing..... 67
Materials..... 67
Medicine..... 69
Metallurgy..... 69
Military Aviation..... 69
Naval Aviation..... 69
Paints and Coatings..... 70
Personnel..... 70
Plastics and Plywood..... 70
Private Flying..... 70
Production..... 71
Propellers..... 73
Radio..... 73
Reaction Propulsion..... 74
Research..... 75
Rotating Wing Aircraft..... 75
Stress Analysis..... 75
Superchargers..... 77
Testing..... 77
Testing Equipment..... 77
Tools and Equipment..... 79
Training..... 81
Weight Control..... 81
Welding..... 81

Heli-Coil INSERTS

INCREASE THE LIFE OF TAPPED THREADS ...100% or more!

If your customers sometimes raise Cain about tapped thread failures in the products you design, build or service . . . it will pay you to investigate Heli-Coil Inserts!

These tough, wear-resistant wire bushings provide a simple and inexpensive method of protecting tapped threads against abrasion, stripping and seizing even where high temperatures are involved. They materially lengthen the life of the original thread by giving it a stainless steel or phosphor bronze lining that resists stud or screw vibration and friction. They are lighter, less bulky and easier to assemble than solid bushings.

Installing Heli-Coil Inserts in original manufacture is a simple operation, described at the right. When Heli-Coils are used in maintenance work to repair a damaged thread—the worn thread is drilled out, a new one tapped and a Heli-Coil inserted. It's as easy as that—and there is no need for oversize screws or studs!

For complete details, write for our latest bulletins.

ENGINEERING REPRESENTATIVES

NEW ENGLAND: Donald McClain, 6 Pioneer Circle, Manchester, Conn.

DETROIT: G. C. Brown and A. W. Reader, 201 South Pleasant Street, Royal Oak, Michigan.

KANSAS CITY: Pacific Airmotive, 1628 McGee Street, Kansas City 8, Mo.

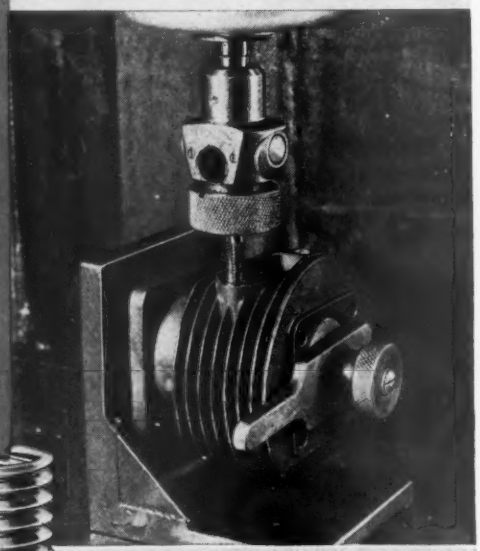
LOS ANGELES: J. S. Wise, Room 925, Pacific Mutual Bldg., 523 West 6th Street, Los Angeles, Calif.

U. S. and Foreign Patents Issued and Pending.

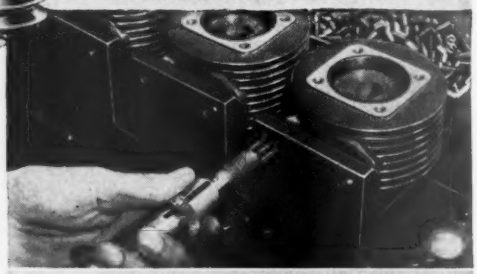
THE SCREW SYSTEM WITH THE ANTI-FRICTION THREAD LINING

HELI COIL

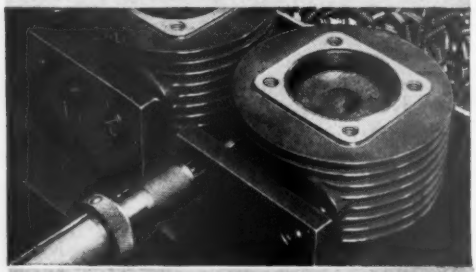
THE Jacobsen Manufacturing Company of Racine, Wis., used two bronze Heli-Coils in the aluminum die cast cylinders of the small gasoline engines it produced for the Signal Corps. Installed in the exhaust flange mounting, exposed to extremely high temperatures, these inserts accommodated two ¼-20 cap screws which held the muffler assembly on the cylinder. The Heli-Coils protected the tapped threads against wear caused by removing the screws when the muffler was taken off to scrape out accumulated carbon from the engine exhaust portholes. Here's how Jacobsen handled the job:



STEP 1: Tap die cast hole slightly oversize — .260 for the ¼-20 screw.



STEP 2: Place Heli-Coil in power inserting tool and run Heli-Coil into pre-winding attachment.



STEP 3: Rotate mandrel of tool to insert Heli-Coil in tapped hole.

AIRCRAFT SCREW PRODUCTS COMPANY, INC.

47-23 35th STREET • LONG ISLAND CITY, 1, N.Y.

into major components comprising fuselage, wing, and empennage, and dividing each of these into smaller units, for which special sets of coordinate axes are developed. Detailed explanations are given of the fuselage reference system, empennage reference system, and the wing rigging.

The third section of Part I gives an analytic description of wing master lines. It is shown that any basic line element that can be identified with a percentage line in an airfoil surface is amenable to analytic calculation methods. *Aero Digest*, November 1, 1945, pages 66–68, 130, 4 illus.

Standard Atmospheric Conditions. G. B. Saksena. It is noted that all aircraft and aircraft-engine performance calculations are reduced to an agreed Standard Atmosphere defined by the International Commission on Air Navigation so that direct comparison between the results can be easily made. It is explained that for design purposes, especially in the design of radiators, this Standard Atmosphere is neither universally adopted nor suitable. Other commonly used atmospheric conditions in Great Britain are Temperate Summer and Tropical Summer. Some of the properties of these atmospheres are given in various air publications issued by the Ministry of Aircraft Production, including *R. & M. 1891*, but with one exception the functions tabulated are inadequate for most practical purposes. To fill the gap, tables are presented giving functions commonly used for Temperate Summer and Tropical Summer atmospheres on lines similar to those used in *R. & M. 1891*. A recalculated table of I.C.A.N. Atmospheric Conditions is also supplied. The theory underlying these calculations is set forth. *Aircraft Engineering*, October, 1945, pages 285–288, 3 illus.

Zur Einfuehrung in die Stroemungslehre zusammendrueckbarer Fluessigkeiten (On the Introduction to the Hydrodynamics of Compressible Fluids). R. Sauer. From the study of the hydrodynamics of compressible fluids in the subsonic and supersonic range, two problems are discussed which are stated to be important in practice. These problems are stationary flow through nozzles and nonstationary flow (propagation of pressure waves) in cylindric pipes. If the study is limited to the isentropic change of state, the wave diagrams may be constructed in a simple manner which is based on the Riemann method.

This manner of construction is also applicable to slight compression shocks. The general ideas are explained by examples, such as the reflection of pressure waves on open and closed ends of a pipe, and also on a wall equipped with valves. *Zeitschrift des Vereines Deutscher Ingenieure* (*V.D.I.*), June 10, 1944, pages 301–307, 14 illus.

Air Cargo

Two-Way Cargo. Lawrence Drake. The transportation of perishables and food products is indicated as the answer to the problem of obtaining "two-way" pay loads in order to make air freight profitable. To facilitate return-trip hauls of food products, it is suggested that "air-borne products' wholesale exchanges" be established. These exchanges would offer a systematic and select market for air-borne products to clubs, hotels, restaurants, retail stores, etc., and also promote the production of all types of unusual and high-quality food products which they would distribute to nation-wide markets. *Skyways*, December, 1945, pages 22, 23, 66, 69, 70.

Non-Scheduled Cargo—A Challenge to Airports. John H. Frederick. Airport operators are advised of the importance of having loading facilities, equipment, and personnel available for private cargo-carrying planes. As a means of determining the types of service and equipment required, the writer takes into consideration the densities of cargo which may be expected, the different kinds of cargo planes and compartments that will have to be handled, and the variations of access means to cargo compartments. It is suggested that a consolidated operation for loading, unloading, and storaging cargo might be of great value at a large airport. *Southern Flight*, November, 1945, pages 52, 54, 2 illus.

Air Policy

An American White Paper on Air Transport. William L. Grossman. In this summary the writer gives his interpretation of the international air-transport policy of the United States. It is stated that the information is based on official sources. The writer discusses the extent to which United States air policy has been crystallized and summarizes the policies established by the several Federal agencies authorized to carry out this work.

He concludes that the nation's international air policy is clear and definite but that two points are still doubtful, these being (1) the extent to which air-surface carrier combinations are to be permitted, and (2) the effect of the "Five Freedoms" agreement upon the President's power to deny a permit to a foreign air line on the ground that it is contrary to the public interest. *Air Transport*, November, 1945, pages 22–27.

Air Power

Air Power in the Atomic Age. Gen. Carl A. Spaatz. Forecasting the probable pattern of future wars, the Commanding General of the U.S. Army Strategic Air Forces in the Pacific stresses a planned and ready air offensive as the only real defense the United States can have against a martial attack employing atomic bombs and airplanes of the future. He indicates trends of development in air power and describes in broad general terms some of the ideas the U.S.A.A.F. has for coping with possible future wars. *Collier's*, December 8, 1945, pages 11, 12, 83, 84, 2 illus.

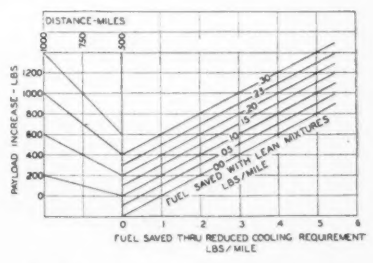
. . . The Same Mistake Again? Elbert D. Thomas. Recalling specific opposition that the development of a strong air force encountered in the United States prior to the first World War, Senator Thomas stresses the importance of formulating at this time sound national policies with regard to aviation. He outlines five major problems concerning military and commercial aviation and gives his views as to how they should be settled. These problems are:

(1) What is the United States going to do toward maintaining its air forces? (2) Are the A.A.F. and the Navy air arm to be separated from other defense groups; will they be made the controlling factors in the American fighting structure or will they be relegated to their prewar status? (3) What measures are to be taken to control the airplane in its relationship to the atomic bomb? (4) What international regulations are to be laid down concerning freedom of the air? (5) Domestically, what measures are to be taken toward full aircraft production and the employment that such production implies? *Flying*, December, 1945, pages 21–23, 100, 104, 106, 3 illus.

Air Transport

The Czechs Won't Be Checked. Ferdinand Trebichavsky. A summary of Czechoslovakia's position with regard to air transport before the war supplements a brief account of that country's present plans for the promotion of commercial aviation. To emphasize Czechoslovakia's particular possibilities for air transportation, two tables list Czechoslovak imports from the United States and exports to the United States. *Air Transportation*, October, 1945, pages 18, 19.

North Pacific Economics. E. T. House. The so-called continental route across the North Pacific is an-


DISTANCE-MILES
PAYLOAD INCREASE - LBS
FUEL SAVED WITH LEAN MIXTURES LBS/MILE
FUEL SAVED THRU REDUCED COOLING REQUIREMENT LBS/MILE

Typical pay-load increases at cruising power, obtained by use of fuel injection in Wright Cyclone 18 engine.

alyzed as being more economically feasible than the island route now being used. Three fundamental factors form the yardstick for the comparative analysis: (1) that the route distance between terminals be as short as practicable; (2) that the intermediate stages be of such length as to permit maximum aircraft stowage capacity to be used, but, at the same time, of sufficient length to allow reasonable economy of aircraft performance; (3) that there be populations and production areas at each terminal and along the route.

With the advocated great circle course shown to possess advantages on all three counts, it is proposed that Great Britain establish an air route along its course. The suggested route would begin at Singapore; have stops at Saigon, Hong Kong, Shanghai, Vladivostok, Okhotsk, Markovo, and Fairbanks; and terminate at Vancouver. *Flight*, November 8, 1945, pages 495–497, 2 illus.

Charter Service as a Revenue Producer. Some of the profit potentialities in an aerial taxi service are demonstrated and advice is offered on specific methods of promoting this type of business. Establishment of standard rate schedules, personal solicitation of charter business, solicitation of seasonal business, and promotion of air contracting work are among the measures advocated. *Western Flying*, November, 1945, page 71.

The Future of World Airlines: India. Lucien Zacharoff. India's commercial aviation potentialities are considered in this eighth article of a series on the civil air-transport prospects of various countries. This study includes in its scope investigation of Indian flying facilities, equipment, personnel potential, operating companies, existing domestic and international airways; the impetus lent to Indian aviation during the war through development by the U.S.-A.A.F. and the R.A.F.; the record of Indian air lines during 1944; expansion between the years 1938 and 1944; public consciousness of aviation; proposed and operating routes; Indian economic and political outlooks; and the country's geographic position. *Air Trails*, December, 1945, pages 36, 37, 90, 92, 94, 96, 97, 5 illus.

Canada . . . World-Air Minded. R. H. Ayre. A brief outline of air-transport development in Canada begins with a background history of Canadian commercial aviation from 1907 to the organization of Trans-Canada Air Lines in 1937. That company's growth from 1937 to the present date is traced and information is given about its operational set-up, routes, equipment, facilities, personnel, etc. *Air Transportation*, October, 1945, pages 7–10, 12, 13, 4 illus.

Let's Look at Bush Planes. Dale S. Atkinson. The fifth article in a series analyzing the potentialities, costs, rates, and revenues of air-transport operation in northwestern Canada is concerned with the type and size of aircraft that could be operated most effectively and economically in Canada's "bush" country. A hypothetic airplane with desired qualities is described and the suitability of the Norseman Mark V for the purpose is considered.

In addition to demonstrating the need for more efficient aircraft if air-transport operations in northwestern Canada are to be made financially feasible, the writer shows that Government subsidy is necessary. Justification of such subsidy is offered. *Canadian Aviation*, November, 1945, pages 79, 80, 82, 3 illus.

Jungle Air Empire. Sidney Swirsky. This survey of the organization, growth, and operations of Transportes Aereos Centro-Americanos (TACA), emphasizes the air-line's beneficial effects upon the economy of Central America. A system of deferred cargo-freight carried at a lower rate than express and accepted for shipment within a minimum number of days is cited as the key to TACA's expansion in the freight-transportation field. Data are included about the company's facilities, equipment, personnel, maintenance problems, and financial and administrative structure. A map depicts the air-line's scheduled, contract, projected, and connecting

THE basis of *thorough engineering* in Lamb Electric motors is an intimate knowledge of the operating conditions of the product.

The soundness of this approach to special motor design is evidenced by the reputation for dependability gained by Lamb Electric motors in both prewar and wartime operation.

THE LAMB ELECTRIC COMPANY • Kent, Ohio

Lamb Electric
FORMERLY Black & Decker Electric
SPECIAL APPLICATION FRACTIONAL HORSEPOWER MOTORS

routes in Central and South America. *Western Flying*, November, 1945, pages 56, 58, 88, 1 illus.

National Air Taxi System. Arthur W. D. Harris. The writer describes a system that would provide nonscheduled flying service to all of the nation's airfields through the linking of local charter-service operators. It is noted that in the past air taxis have been purely a supplementary service operated much the same as the owner of a one-man taxicab in a small town operates his hack. When a single passenger charters an airplane for a one-way trip it is often necessary to charge for the round trip because there is no pay load to bring back. Details are given about a reciprocal plan for securing return pay loads for chartered airplanes. *Aviation Maintenance*, November, 1945, pages 37–40, 137–139, 141, 4 illus.

What D'Ya Read? . . . By Air. Capt. R. A. Cooke. The potentialities of air-cargo service for the distribution of daily newspapers to distant points are considered. Explaining principal deterrents in the use of air service for newspaper distribution at the present time, the writer claims that if rates are reduced and regular service established, newspapers will be delivered by air in volume. He states that newspapers have favorable transportation characteristics and therefore should be accorded a more reasonable basis of rates for carriage by air. The suggestion is offered that such rates should be predicated on a mileage group basis with a descending per ton-mile return as distance increases. *Air Transportation*, October, 1945, pages 20–22, 24, 2 illus.

British South American Plans. The combined plans of five British shipping companies to operate an unsubsidized air line to South America are related. Functioning under the name of British South American Airways, the concern will employ Lancasters (converted into the equivalent of Lancastrians) to transport passengers. The estimated flying time will be 35 hours and the fare from Britain to Argentina is expected to be £155. Shipping companies associated in the venture are Royal Mail Lines, Blue Star Line, Pacific Steam Navigation, Booth Steamship, and Lamport and Holt Line. *Flight*, November 1, 1945, page 484.

Commercial Aviation and the Portuguese Triangle. Jose Bensaude. Explaining the urgent need for air service between Portugal, the Azores, and Madeira, the writer also advocates an interisland air line for the Azores. The benefits to be derived from such an interisland air line in terms of air and general commerce are discussed. *Air Transportation*, October, 1945, pages 62–65, 3 illus.

Airplane Descriptions

Avro Lincoln II. Additional details are presented about the Avro Lincoln II, pertaining to the bomb load, radius of action, armament, power plant, electrical system, flying characteristics, controls, and wing structure. Similarities of the Lincoln II to both the Avro Lancaster and the Avro Tudor I are noted. A table of specifications lists the figures for the Lincoln's span, length, height, wing area, aspect ratio, dihedral, airfoil, wing loading, and maximum weight. *Flight*, November 1, 1945, pages 467, 468, 3 illus.

Experimental Aircraft. Information is given about two projected airplane types. One is the Aerobat, designed by Ellis Eichman; the other a "tail-first" model designed by Richard E. Naugle. An unconventional-looking plane that seems to be of the all-wing type, the Aerobat is said not to be subject either to spin or stall. It has a cruising speed of 75 m.p.h., a top speed of between 95 and 100 m.p.h. The controls consist of rudder pedals and a wheel, rather than a stick. It is reported that the Aerobat will probably sell for about $2,000 to $2,500.

The Naugle design calls for a 75- or 90-hp. engine, all-metal wings, and a molded plastic material for the nonstressed fuselage. With its laminar-flow fuselage and wing, it is expected to have a speed of approximately 150 m.p.h. Its probable selling price is placed at from $1,500 to $1,800. *Skyways*, December, 1945, pages 27–29, 5 illus.

Taylorcraft Auster V. In an examination of the characteristics and functions of the Taylorcraft Auster V, the versatility of this low-powered light airplane is emphasized. Its adaptability for skis and floats is especially noted, along with its usefulness in the laying of telephone cables and the picking up of mail bags. *Flight*, November 8, 1945, pages 498–500, 12 illus.

The Naval Aircraft Exhibition and Display. A review of new British naval aircraft, as observed at an exhibition held at Heston Airdrome. Among the aircraft described are the Miles Monitor II; Fairey Barracuda V, Spearfish I, and Firefly IV; Blackburn Firebrand IV; Supermarine Seafang and Seafires XV, XVII, XVIII, 45, 46, and 47; Hawker Sea Fury X; and de Havilland Sea Mosquito 33, Sea Hornet 20, and Vampire. Photographs illustrate several of the airplanes mentioned. *The Aeroplane*, October 12, 1945, pages 418, 421, 424, 2 illus.; "Navy's Newest Displayed," *Flight*, October 11, 1945, pages 385–387, 8 illus.

Aeronca Champion. Leighton Collins. A report on the handling and flying characteristics of the Aeronca Champion includes suggestions to flight instructors on important flying factors to be taught the student pilot. The writer also advises on efficient methods for teaching these flight procedures. *Air Facts*, December, 1945, pages 72–85, 5 illus.

Firefly IV. An account of the design, construction, and performance of the Fairey Firefly IV stresses the modifications that have been made in the latest version of the Fleet fighter plane. Among the changes discussed are the new cowling, leading edge radiators, and clipped wings. Another feature to which particular attention is called is the thermostat cooling control. Specifications for the Firefly IV are tabulated. *Flight*, November 8, 1945, pages 493, 494, 6 illus.; "The Fairey Firefly F. Mk. IV," *The Aeroplane*, November 9, 1945, page 533, 3 illus.

Britain's Latest. Principal dimensions and outstanding features are noted of several Royal Air Force and Fleet Air Arm aircraft recently released from the secret list. The airplanes surveyed are the Avro Lancaster, de Havilland Hornet, de Havilland Vampire, Spitfire XXII, Vickers Armstrongs Seafang, Seafire, Hawker Sea Fury, Blackburn Firebrand IV, Fairey Barracuda V, Fairey Spearfish, Miles Monitor II, and Bristol Buckmaster. *Aircraft Production*, November, 1945, pages 537, 538, 2 illus.

Civil Auster. A description is given of a three-seater civilian version of the Auster light airplane, manufactured by Taylorcraft Aeroplanes (England) Ltd. It is stated that basically the air-frame and general structural details are the same as those of the military Auster, and the modifications that have been made to adapt it for civilian use are emphasized. Particulars are given about the interior finish of the cabin, the structure of the fuselage and other components, and the engine. Comments are made regarding the flying qualities of the airplane, its ability to withstand frequent take-offs and landings, the control equipment, and other qualities. A table gives the general specifications. *Flight*, October 18, 1945, pages 411–413, 7 illus.

Introducing the Fleet "Canuck." Ronald A. Keith. A report of the operational and design features of the first Canadian-designed light airplane to go into commercial production. The two-seater Canuck is described as having an all-metal fuselage, cruising speed of about 100 m.p.h., range of 400 miles, and service ceiling of 12,000 ft. It is expected to sell for a little over $3,000. Performance, weights, and dimension figures are listed. *Canadian Aviation*, November, 1945, pages 38–40, 101, 6 illus.

The Bristol Buckmaster. Design, construction, and performance details of the Bristol Buckmaster are reviewed. Designed to give a close approximation to the flying qualities

Another Aviation First
that includes AEROLS!
Passenger and cargo service between New York and London by land based aircraft—this significant advance in airline travel has recently been inaugurated by the American Airlines System. Flagships for these overseas flights are reliable, four-engined DC-4's which are equipped with Cleveland Pneumatic's Aerol landing gear.
At each stop, Aerols efficiently absorb the landing shock and help the plane come in safely — insuring comfort and safety for passengers and crew. Thus Aerols contribute substantially to the success of these pioneering flights.
THE CLEVELAND PNEUMATIC TOOL CO.
AIRCRAFT DIVISION • CLEVELAND 5, OHIO
AEROLS*
*PNEUMATIC-HYDRAULIC (AIR-OIL) SHOCK ABSORBING LANDING GEAR

of large operational aircraft, it is an advanced trainer with two engines developing more than 2,500 hp. each. The Buckmaster has a top speed of 352 m.p.h., a gross weight of 33,700 lbs. and a service ceiling of 30,000 ft. It is a midwing all-metal monoplane equipped for training purposes as a three-seater airplane. In addition to the flying controls, there is a dual set of controls for the operation of undercarriage, flaps, brakes, propeller speeds and feathering, and engine throttles. *Flight*, October 18, 1945, pages 420, 421, 2 illus.

American Transports 1946. A compendium of photographs and drawings shows the aircraft that are expected to carry American air traffic and cargo during the coming year. Accompanied by descriptive data, the illustrations are those of the Boeing Stratocruiser and Stratoliner; Republic Rainbow; Fairchild Packet; Burnelli CBY; Consolidated Vultee Models 37, 110, and 39; Martin 202–11 and Mars; Lockheed Saturn; Hughes H-4 and Flying Office; Curtiss-Wright Commando and CW-28; and Douglas Skytrain Glider, Globemaster, Skymaster, DC-6, and DC-8. *Skyways*, December, 1945, pages 44–57, 27 illus.

Twin Trainers. "Indicator." The second of a series of articles reporting on the handling characteristics of twin-trainer types is concerned with the Avro Anson. The evaluation of the Anson's handling qualities is based largely on a comparison with the Airspeed Oxford, called by the writer the true intermediate twin trainer. *Flight*, October 18, 1945, pages 421, 422, 2 illus.

Airports and Airfields

Tailoring Airport Plans to Community Needs. Leigh C. Fisher. A course of action is prescribed for making an accurate appraisal of the type of aircraft needed to meet the requirements of a specific city and then drawing up the plans for the "custom-made" airport.

In outline, the recommended course is as follows: (1) Gathering of all economic, occupational, and personal information from the community and its population, including the surrounding trade areas and smaller cities. (2) Consideration of adjacent population areas which have the potentiality of either aiding or impairing the community's airport operation. (3) Careful analysis of the data gathered so that the estimate of use to be expected will be ascertained accurately. (4) Determination of the present need for airport facilities by interpreting the information gathered. (5) An estimate or projection of the future need based on the information gathered. (6) Planning the airport so that it fits the community need at the present and so that it can be expanded to meet the community need at any time in the future. (7) Adjusting the plan of the airport to meet the financial ability of the community and to reflect the possible revenues that can be obtained from the airport's operation. (8) Designing each phase of the airport and its facilities and orienting these services and facilities in a pattern whereby the maximum amount of revenue can be obtained with the minimum investment. *Southern Flight*, November, 1945, pages 50, 51, 61.

Airports for Everybody. Brien McMahon. The U.S. Senator from Connecticut interprets the main points of the Surplus Airport Act of 1945, introduced by him as Senate Bill No. 1398. The necessity for the proposed legislation is explained, as well as the advantages it would bring both to the nation and to aviation development. The bill specifies that title to some $2,000,000,000 worth of ready-built Army, Navy, and other Federally-owned landing areas in continental United States—plus Federally-owned hangars and other equipment—be turned over to state, county, municipal, or other political ownership.

The Senator comments on the facilities to be declared surplus and on certain clauses in the McCarran Airport Bill, indicating how this bill also would aid in the program of general expansion for U.S. airports. *Flying*, December, 1945, pages 29, 72, 74, 78, 1 illus.

Shoulder Gutters Check Airfield Erosion. Harold A. Scott. How shoulder gutters were used to check the erosion by storm runoff at the Jacksonville, Fla., airfield is described. Wide gutters, discharging to catch basins or spillways, were constructed at the edges of the shoulders. It is stated that surveys show no erosion since the gutters have been in operation, despite heavy rainfalls. *Engineering News-Record*, November 29, 1945, pages 80–82, 6 illus.

Airport Supplement. A special section of the November issue of the magazine *Parks and Sports Grounds* contains several articles dealing with airports and ground engineering. One of these outlines the airport plans of the city of Manchester, England, and vicinity; another is a general article about airport design; a third tells about the terminal factor in airport planning; and the fourth outlines the features of a model airpark. *Parks and Sports Grounds*, November, 1945, 25 pages, 8 illus.

Airport for $400. Mary Brown. An account is given of how the airport at Richmond, Ore., was constructed in one day at a total cash expenditure of less than $400. The information includes particulars about the layout and facilities of the airport, which was constructed for student-training operations and for use by small, privately owned airplanes. *Flying*, December, 1945, pages 35–38, 112, 114, 7 illus.

Trans-Atlantic Toehold. Rex MacGall. The writer describes the advantages offered by Eire Shannon Airport. The importance of this airport to American transatlantic airline operators is emphasized. Information is given about the facilities of the airport. It is noted that the traffic staffs of Aer Lingus Teoranta, stated to be the only Irish international air-transport company in existence at present, are being trained at Shannon airport. A brief history of this air line is included. *Air Transport*, November, 1945, pages 60, 63, 66, 5 illus.

Check That Compass. Jack Andresen. The value of including a compass rose in an airport's facilities is discussed. The rose is shown to yield advantages in safety, convenience, and increased airport business. *Southern Flight*, November, 1945, pages 56, 62.

Airport Emergency Lighting: Are You Prepared for a Power Failure? Robert B. Ely. Methods of preparing for failure of the airport lighting system are described. Consideration is given to an auxiliary service to the airport by means of a separate feeder from the central station, and to an isolated plant at the airport to carry the lighting load. The use of less expensive portable equipment placed in parallel rows alongside the runway 400 ft. apart is also discussed. Other emergency equipment considered include oil lanterns, portable electric light units, reflector markers, and floodlights mounted on a truck. *Aviation Maintenance*, November, 1945, pages 52, 53, 116, 6 illus.

Westair Helicopter Terminal. As presented at a press conference in New York recently, plans are proposed for the construction of a helicopter airport and terminal in the area directly behind the General Post Office, New York City, above the depressed railroad tracks leading into Pennsylvania Terminal. The desirability and feasibility of such an air terminal are pointed out; a drawing of the structure is shown; and routes are outlined from the terminal to five airports in the metropolitan area. The flight time is computed to La-Guardia, Idlewild, Newark, Westchester, and MacArthur airports. *Air Transportation*, October, 1945, pages 14–16, 1 illus.

Avigation

Standard Computers Aid the Avigator. Lawrence LeKashman. A review of the functions, characteristics, and features of representative types of equipment for navigators. The devices discussed include vector-solving general computers; an automatic bombing computer; drafting instruments; dividers; triangles; splines; drafting machines and chart tables;

special-purpose computers; load adjusters; prepared navigational forms; and carrying cases.

Among the specific items described are the Army Air Forces E6B, Weems Mark 3A, and Cox & Stevens general computers; Army Air Forces "ABC" automatic bombing computer; Weems plotter; Air Forces Type G-1 computer for the determination of true air speed; Air Forces C-2 computer for the determination of absolute altitude; and Air Forces A-5 course and distance computer. *Aero Digest*, November 15, 1945, pages 56, 57, 127, 131, 132, 7 illus.

Finding the Navigational Stars. Part XI. Ben C. Kenny. The eleventh part of a series about celestial navigation gives advice concerning the acquisition of a thorough knowledge of the celestial sphere as a whole. By continual review, adding new stars as they are identified and relating them to known groups and to the larger geometric figures, helpful mental associations are built up for large areas of the sky. The use of a map or globe of the celestial sphere is recommended, such as the map found in the *Air Almanac*, on which all of the navigating stars are labeled.

The writer then proceeds to a description of the constellation Perseus, featured by two streams of stars which intersect at their northern tips, and of the Pleiades and the Hyades in the constellation Taurus, both of which groups are visible from the United States at this time of the year. These groups are helpful in locating two additional navigating stars that lie in the south circumpolar region. Directions are given for identifying the navigating star Deneb Kaitos in the constellation Cetus, and Acamar in the constellation Eridanus. Deneb Kait, as it is abbreviated in the *Air Almanac*, is found by extending the eastern side of the Great Square of Pegasus southward a distance of twice its length, at which point Deneb Kait is about in line with Marfak and Hamal. Acamar is low in the southern sky, almost in line with Ruchbah and Hamal.

Two night photographs of the portions of the sky mentioned are accompanied by key diagrams to assist in finding the stars. *Aero Digest*, November 15, 1945, pages 60, 61, 4 illus.

Business and Finance

Accounting for Flight Income. Todd Mumma. The third in a series of articles devoted to accounting systems for airports and aircraft service operators. The writer describes the forms and methods required to record income from flight instruction, air taxi service, passenger flights, and aircraft rentals. Forms for keeping daily and weekly flight records, and aircraft-performance records are illustrated. *Aviation Maintenance*, November, 1945, pages 54–56, 98, 3 illus.

Bottleneck in Financing Foreign Air Cargo. A. M. Strong. The writer warns that airway bills of lading presently used by air carriers do not meet with bank requirements, since they do not convey title to the merchandise. He explains the need for complying with financing requirements if international air trade is to be developed and recommends immediate steps to remedy the current situation. *Air Transportation*, October, 1945, pages 69, 70, 1 illus.

With Ready Money Mounting It's "Cash and Carry-On." Raymond L. Hoadley. An analysis of the aircraft industry's favorable cash position which results from the Tax Adjustment Act. It is explained how tax savings, refunds, termination payments, and adjusted amortization claims will give aircraft manufacturers the necessary working capital to consolidate their earning power. *Aviation*, November, 1945, pages 112, 113.

Air Line Stocks. An analysis is given of the present status and future prospects of companies engaged in commercial air transportation, with particular reference to the investment position of the stocks of those companies. It is stated that a substantial rise in the volume of freight, passenger, and mail traffic is expected, although the increase in gross revenues and net incomes of the companies will probably be slower than the rise in physical volume. It is assumed that within the next 2 years there will be an increase of 100 per cent in revenue passenger-miles and mail-pound-miles; a net increase of 50 per cent in all other revenues; a 20 per cent reduction in passenger rates and 33 per cent in air-mail pay; an increase of 100 per cent in aggregate aircraft-operation expenses; and a 50 per cent increase in the aggregate of ground and indirect operating expenses. Upon these five assumptions, with allowance for additional capital investment in equipment and applying 1946 tax rates, a table lists expected earnings for 1946, compared with those for 1945. *Moody's Stock Survey*, November 12, 1945, pages 85–89.

Aircraft Manufacturing Stocks. Companies engaged in the manufacture of aircraft whose stocks are listed on the New York Stock Exchange are analyzed from the standpoint of business prospects and earnings. The industry's large financial gains of the war years are contrasted with the relatively small change in the aggregate market value of the stocks. Figures representing the combined balance sheets of nine companies show that the equities represented by the common stocks increased $300,000,000 in the 5 years ended December 31, 1944, whereas recent average prices have gained only $43,200,000 in aggregate common-stock values. The nine airplane manufacturing companies mentioned are reported to have retained military contracts with a total value of about $900,000,000, after heavy cutbacks. It is noted that recommendations have been made for the Government purchase of 3,000 military airplanes, costing $750,000,000 per year in 1946 and 1947. It is estimated that the air lines will buy 325 to 475 airplanes yearly and that the nine companies have, at present, commercial orders aggregating $263,000,000, in which the majority is for delivery in 1946 and 1947. Retirement of 25 per cent of the present number of airplanes is expected in each of the 2 years, involving an additional business volume of approximately $100,000,000 per year. A table is given of statistics on the nine companies, showing comparative assets, average earnings for the periods 1935–1939 and 1940–1944, and potential earnings for 1946. A chart shows the market movements of the average prices of these nine stocks. A tabulation is given of the estimated current orders and probable new military and commercial aircraft products. Individual analyses are made of the nine companies. *Moody's Stock Survey*, December 3, 1945, pages 49–56, 1 illus.

Civil Aviation

So You Want to Fly for a Living? Lt. Frank L. Harvey. A consideration of the opportunities in civilian aviation for ex-military pilots. The pilot is advised about factors he must investigate and analyze before embarking upon peacetime enterprises of charter flying; airplane dealerships; flight instruction; air-line piloting; and such commercial aviation projects as swamp spraying, fire fighting, etc. Another career possibility suggested for the service pilot is continuance in military flying. *Air Facts*, December, 1945, pages 31–34.

Certain Death for Non-Scheduled Aviation. A. H. Knouff. A protest against CAR Part 42 providing for economic regulation of fixed-base operators. The writer expresses the opinion that not only is it a false premise to claim such regulations necessary for the protection of the air lines, but also that it is to the nation's interest to encourage nonscheduled aviation rather than to hamstring it. Attention is called to what are regarded as specific evils in Part 42, as revealed in CAR Draft Release No. 58—sections 4.10, 42.10, and 42.13. *Southern Flight*, November, 1945, pages 46, 47.

Control Equipment

Theory of Automatic Control Systems. Part II. Donald P. Campbell. The second of a series of articles on the analysis and design of automatic control systems. It is noted that the method of mathematical analysis used to describe the behavior of the idealized torque amplifier for positioning aircraft control surfaces can be used as a model for general analytic study

of automatic control systems. The same example may also be used as a foundation upon which the more advanced theory of closed-loop control can be established preparatory to discussing automatic-pilot performance and design. For expediency, the study of dimensionless analysis methods, anticipation or derivative control, and integral control is presented in this manner. *Industrial Aviation*, November, 1945, pages 38–40, 54, 3 illus.

Aircraft Electronic Controls—Design and Application Problems. Col. T. B. Holliday. Factors governing the design and use of aircraft electronic controls are discussed. Important factors considered include size, weight, and environmental conditions. The characteristics of electronic tubes and their applications to aircraft-control problems are described. Typical controls used on aircraft are illustrated by schematic drawings. *Product Engineering*, November, 1945, pages 750–752, 3 illus.

Deicing

Correct Servicing Determines De-Icer Efficiency. Part II. The concluding section of a two-part article on the maintenance of deicing equipment details successive steps in making all types of deicer repairs which involve vulcanizing. With curing times calculated, the "do's" and "don'ts" are given for each particular repair operation discussed. Instructions pertain to the following: curing procedure; conductive-surface repairs; flap repairs; stretch-area repairs in deicers with and without sponge filler; tube-area repairs; air-connection repairs; bead repairs; end-reinforcement repairs; and snubber repairs. *Aviation*, November, 1945, pages 162–164, 250, 252, 254, 256, 257, 3 illus.

Design

Planes That Missed the War. Lt. Col. N. F. Silsbee. A summary of American and British planes whose employment in the war was barred by the sudden cessation of hostilities in the Pacific. Among the aircraft mentioned are the Lockheed P-80A Shooting Star jet-propelled fighter; Consolidated Vultee XP-81 fighter with General Electric gas turbine for propeller drive in the nose and I-40 turbo jet in the tail; North American P-82 double Mustang fighter; Ryan FR-1 Fireball composite-engine fighter (reciprocating engine in nose, jet engine in tail); Grumman F8F Bearcat; new version of the Corsair F2G; de Havilland Vampire jet-propelled fighter; de Havilland Hornet; Avro Lincoln; Northrop XB-35 Flying Wing; Consolidated Vultee XB-36; and Douglas XB-42. Features of these various types and the advantages they might have brought to the Pacific war are considered. *Skyways*, December, 1945, pages 19–21, 64, 8 illus.

New Type Flaps Lower C-74 Landing Speed. Schematic drawings accompany an explanation of the design, construction, and operation of the combination double-slotted flaps and ailerons that have been incorporated in the Douglas C-74 Globemaster. The new-type full-span flaps are built in six segments, two of the conventional split type beneath the fuselage; one double-slotted type on each side extending from the fuselage to the normal aileron position; and one "ailerflap" on each side from there to the tips.

It is reported that, because of the full-span flaps, landing speed of the C-74 is reduced by about 15 per cent, with the total lift being distributed among the surfaces in the following proportions: underfuselage split flaps, 10 per cent; double-slotted inboard flaps, 65 per cent; and the double-slotted outboard ailerflaps, 25 per cent. *Aviation*, November, 1945, pages 150, 151, 3 illus.

Application of High Strength Plastic to Monocoque Wing Construction. W. I. Beach. Reference is made to recent progress in the molding of high-strength plastics by the so-called "low pressure" method, and to the possibilities of this process in the future production of aircraft. A high-strength plastic monocoque wing design is suggested. An analysis is made of the advantages and disadvantages of this type of construction. *Automotive and Aviation Industries*, November 15, 1945, pages 25–27, 120, 3 illus.

Designing Tomorrow's Personal Plane. Part VI. Ralph H. Upson. In the sixth section of a serial article dealing primarily with the landplane, the writer digresses somewhat to give consideration to the amphibian. He surveys the advantages and disadvantages of the amphibian for the average private airplane owner and proceeds to a review of the engineering problems involved in providing adequate take-off performance, load capacity, range, and other characteristics within the limitations of weight, cost, wing and power loading, and other factors imposed by the purposes for which the plane is designed.

Particulars are given, with supporting formulas, with respect to primary and secondary drag, and for the conversion of a landplane. Alternative design arrangements are suggested by which the weight, power, and cost of an amphibian can be made comparable with those of a "roadable" type of landplane of similar size. It is concluded that a suitable market can be developed for amphibians at a price level approximately 50 per cent greater than for equivalent landplanes, especially if they are of a type that can be produced largely from landplane parts and by existing plant equipment. *Aviation*, November, 1945, pages 136–139, 4 illus.

What'll You Have—High Wing or Low? Ralph H. Upson. The comparative merits of high-wing and low-wing private-airplane designs are discussed with regard to cost, safety, vision, and performance. Although advantages and limitations are indicated for each type, the writer favors the low wing as the safer and more generally practical of the two. *Air Facts*, December, 1945, pages 20–25.

Analyzing the Aspects of Future Flight. Part I. C. E. Pappas and M. G. Harrison. Problems involved in future extreme high-altitude flights at speeds in excess of that of sound are studied from the standpoint of the heating effects of surface friction of the air, instability of flow, effects of meteoric dust, and power required for flight. It is noted that the power needed to fly at altitudes where the atmosphere is appreciable would be prohibitive for conventional planes, calling for about 40,000 hp. at 50,000 ft. for a Mach Number of 2.0. Special airfoils would have to be employed, involving difficulties in finding space for the retraction of landing gear and for fuel storage.

Detailed consideration is given to the question of heating effects caused by the friction of the air particles moving over the surfaces of the airplane. Reference is made to experiments with various kinds of films and to studies and formulas dealing with the shock waves and stability of airflow. The current installment concludes with a consideration of the flow over an airfoil at sonic speeds. *Aviation*, November, 1945, pages 131–134, 5 illus.

Design Details of the Northrop P-61. Part I. The first part of a design analysis of the Northrop P-61 sets forth particulars relative to the wing structure and assembly, flaps, ailerons, tabs, cockpit, gun turret, tail booms, empennage, and fuel systems. It also contains general details about this fighter plane's construction, dimensions, performance, power, and equipment. Several sectional drawings illustrate various components and assemblies of the P-61. *Aero Digest*, November 1, 1945, pages 54–58, 6 illus.

Design Analysis of Messerschmitt Me-262 Jet Fighter. Part II. John Foster, Jr. The second part of a comprehensive engineering analysis of the Messerschmitt Me 262 deals with the Junkers Jumo 004 gas-turbine jet-propulsion power plant used for the Me 262. The design of the power plant, its installation in the fighter plane, the fundamental prin-

Type of 6-engine Clipper Pan American World Airways will place in service in the future.

New Horizons... IN SPARK PLUG PERFORMANCE

Wartime necessity produced technological advances in Champion Spark Plugs which were outstandingly evident in the performance of the most advanced military aircraft engines.

Today, there are new horizons in spark plug performance for every aircraft engine, commercial and private. The unequalled manufacturing facilities and experience exclusive to Champion are back of every Champion Spark Plug. That's why it will pay you to insist on dependable Champions. They are available in sizes and types for every engine and insure maximum performance and dependability under every operating condition. Install Champions and fly with confidence. Champion Spark Plug Company, Toledo 1, Ohio.

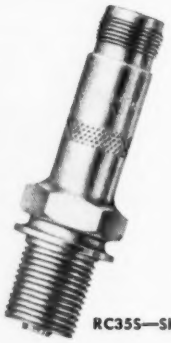
C26—Unshielded

DEPENDABLE

CHAMPION

SPARK PLUGS

FOR EVERY AIRCRAFT ENGINE



RC35S—Shielded Type

ciples of jet propulsion upon which it operates, and the design and production compromises made necessary by limitations of materials, are reviewed in detail. Numerous drawings and tables of data supplement the survey. *Aviation*, November, 1945, pages 115–130, 23 illus.

Design Analysis of the Northrop "Black Widow." Richard Spencer. Constructional features of the P-61C all-metal monoplane are examined. It is noted that this latest version of the Black Widow night fighter is more powerful than preceding models and is equipped with a new air brake that enables the pilot to slow the plane in flight for steadier aim in firing. Each of the two Pratt & Whitney engines is provided with two superchargers, these being a single-stage, single-speed unit and a conventional exhaust supercharger, both of which can work as a unit.

Details are given about the design of the various components of the aircraft. Particular attention is given to the construction of the flaps, wing structure, and empennage. The electrical and hydraulic systems are described. Illustrations show production operations on various units and a cutaway view of the complete plane. *Industrial Aviation*, November, 1945, pages 7, 8, 10–13, 56, 57, 12 illus.

Landing Analyses for Flying Boats and Seaplanes. Part II. Ernest G. Stout. The second installment of an analysis of landing phenomena with respect to large seaplanes and flying boats reviews the two generally accepted methods of studying rough-water performance to obtain accurate information about accelerations and handling characteristics through the use of scientific instrumentation. The first involves the installation of accelerometers throughout the airplane and operating the craft in rough water with observers on board to record the data. The disadvantages of that method are outlined, including the elaborate instrumentation required, the difficulty of mechanical measurement under rough-sea conditions, and the possible loss of the plane with all the records. The second method involves photographic analysis by the use of a motion-picture camera and a film projector. The plane's landings and take-offs are photographed from a surface vessel and the film records are analyzed by means of descriptive geometry. A detailed explanation is given of the process and of the computations made in the analysis of the films.

The writer then explains a procedure developed by himself for analyzing landing-impact forces by what he calls the "impact integral." The theory is applied to the measurement of buoyancy, "wetted" length, beam, and draft of the hull, and other computations. Examples are given to show the application of the method. *Aviation*, November, 1945, pages 140–146, 10 illus.

Electrical Equipment

Constant-Speed Drives for Aircraft Alternators. C. J. Breitwieser. An analysis is made of problems connected with the design of constant-speed drives for alternators for large aircraft in which the main engines are the source of power for the electric system. The characteristics of finite-ratio and infinite-ratio drives for maintaining the alternator within a certain specific speed range are compared. Consideration is given to infinite-ratio couplings, infinite-ratio mechanical drives, and infinite-ratio hydraulic drives. Methods of improving the efficiency of a variable-ratio type of hydraulic drive are discussed. *Electrical Engineering*, November, 1945, pages 763–768 (Transactions), 17 illus.

Factors Influencing Choice of an Electrical Power System for Aircraft. E. R. Siefkin. The various factors that influence the choice of an electrical power system for aircraft are outlined and discussed. The characteristics of d.c. and a.c. systems are compared on points of utilization and distribution, and a summary is made of the advantages and disadvantages of different power systems now in use or under development for aircraft. Four factors cited as principal ones upon which selection should be based are (1) type of mission or operation; (2) range of airplane; (3) comparative weights of different electrical systems; and (4) service and maintenance.

Other considerations investigated include the nature of electrical loads, safety and reliability, cost of complete electrical system, space required for installation and maintenance, commercial availability of equipment and spare parts, radio interference, magnetic compass interference, overall efficiency, provisions required for emergency or standby power and ease of operation. *Aero Digest*, November 1, 1945, pages 91, 92, 95, 142, 144, 147, 1 illus.

Instability in D-C Aircraft Systems. H. B. Bunce, J. C. Cunningham, and W. M. Davidson. Details are given about a laboratory and theoretic study that was made to determine the causes and methods of combating an unstable oscillatory voltage condition that has been encountered in aircraft d.c. electric systems, using types P-1, P-2, and R-1 generators with carbon-pile voltage regulators. The generator characteristics were found to be such that oscillatory instability would not occur without the presence of a voltage regulator that was out of adjustment and that had inadequate damping. A method is given for determining the amount of damping required for stable operation in terms of the generator-field time constant and certain regulator characteristics. *Electrical Engineering*, November, 1945, pages 786–791 (Transactions), 8 illus.

Engines

Some Practical Applications of Rubber Dampers for the Suppression of Torsional Vibrations in Engine Systems. R. W. Zdanowich and J. E. Moyal. Development of a new method of designing a rubber damper for the suppression of torsional vibration in engine systems is reported. This method, which is based on a study of the engine as a whole in conjunction with the damper, can be used to predict the behavior of a damper designed to deal with a certain troublesome mode of vibration. The method indicates that there is no rigid relationship between the frequencies of the engine damper and that the free end of the crankshaft is not the only place where a successful damper can be fitted. Particulars are given also about the physical and other properties of rubber, and the calculation of the heat dissipated by dampers.

Practical support to the theory is provided by accounts of trials carried out on high-speed gasoline engines, a high-speed medium-power Diesel engine, and a slow-speed high-power Diesel engine. *Proceedings of the Institution of Mechanical Engineers*, Vol. 153, 1945, pages 61–82, 32 illus.

Local Coefficients of Heat Transfer for Air Flowing Around a Finned Cylinder. W. H. McAdams, R. E. Drexel, and R. H. Goldey. A description is given of an apparatus for measuring local coefficients of heat transfer for a jacketed or baffled-finned cylinder. The inner surface of the vertical cylinder was divided into narrow vertical segments to collect steam condensate, to provide a measure of the local flux. Since the overall heat balances agreed within a few per cent, local heat balances were used to calculate local air temperatures. Wall temperatures of the base of each segment were measured by calibrated thermocouples, and local coefficients of heat transfer were determined at eleven stations around one-half of the cylinder. The results were easily duplicated and the condensate from the undivided side agreed closely with that from the divided side. Average surface coefficients from fins to air agreed satisfactorily with published data. For a given Reynolds Number, temperature difference had no effect on the Stanton Number. *Transactions of the A.S.M.E.*, November, 1945, pages 613–620, 14 illus.

Aero Digest's Chart of Statistical Data on Aircraft Engines Currently in Production in the United States. In tabular form, specifications and data are listed for 89 current U.S. aircraft

TODAY you can name any number of instances where life itself depends upon the reliability of individual engine or machinery parts. In aircraft for instance. And that's one reason why so many leading engine and machinery builders are specifying Shenango-Penn centrifugal castings . . . because these castings definitely offer superior strength and durability.

The reason is simple. Tubular parts cast by Shenango-Penn's centrifugal process have greater density, more uniform grain structure, higher tensile strength, better elongation, no blowholes, less porosity. Thus they are better able to withstand shock and all kinds of punishment, and they wear longer.

So if you require tubular or ring parts that must *not* part, Shenango-Penn castings are the best kind of insurance. Bulletin 143 gives complete data including cost-saving production advantages, alloy specifications, physical and chemical properties, etc. Write to Shenango-Penn Mold Company, 2257 W. Third Street, Dover, Ohio.

The circular parts shown above were cast centrifugally by Shenango-Penn in tubular shapes and then cut off to precise thickness. All machining and finishing operations including drilling were also performed in the Shenango-Penn shops where the most modern machine tools are available to turn out completely finished parts if desired.

Data Bulletin 143 is yours free for the asking.

ARMY NAVY SHENANGO -PENN

ALL BRONZES • MONEL METAL • ALLOY IRONS

engines. The information for each engine includes the manufacturer's name, the model number, take-off horsepower, number of cylinders, supercharger data, compression ratio, octane rating, bore, stroke, r.p.m., and weight. Other statistics relate to the oil pressure while cruising, oil pressure while idling, spark-plug gap, magneto breaker-point gap, valve clearance cold, valve clearance timing, ignition timing (before top center B.T.C.), spark-plug type, oil viscosity, spark-plug torque, oil temperature range, intake opens B.T.C., and exhaust closes (after top center A.T.C.). *Aero Digest*, November 15, 1945, pages 54, 55.

Fuel Injection for the Aircraft Engine. Part IV. F. J. Wiegand and D. W. Meador. The fourth and concluding installment of an article discussing the requirements for fuel injection and comparing the performance of the fuel-injection aircraft engine with that of the conventional carburetor engine. To round out the study and illustrate the manner in which the comparative data can be applied, the writer completes an analysis of large aircraft and evaluates the advantages and disadvantages when fuel injection is applied. Charts are included which show the typical fuel saving with fuel injection, the potential saving with leaner fuel mixtures, typical effects of reduced cooling requirement, the estimated total improvement at cruise power, typical pay-load increases with fuel injection, and typical range increase with fuel injection. *Industrial Aviation*, November, 1945, pages 27, 28, 30, 60, 61, 6 illus.

Detection of Detonation and Other Operating Abnormalities in Aircraft Engines by Means of Special Instrumentation. John W. Streett. The writer reviews the history of the development of laboratory equipment for detecting and evaluating detonation in large aircraft engines. A precision laboratory device for the purpose, developed as a result of this research work, is described. It is explained that this instrument, in addition to determining the degree of detonation, serves as a valuable indicator of other abnormalities within the engine cylinder. The developmental work necessary to accomplish this purpose at the Wright Aeronautical Corporation is traced, together with a detailed discussion of operating techniques and interpretation of various phenomena indicated. The outlook for future development also is briefly considered. *SAE Journal*, November, 1945, pages 660–669 (Transactions), 13 illus.

Heat Transfer from a Baffled-Finned Cylinder to Air. A. W. Lemmon, Jr., A. P. Colburn, and H. B. Nottage. It is pointed out that in air-cooled aircraft-engine cylinders, the process of heat transfer to the flowing air stream differs from that of usual finned tubes not only in size of the cylinder but also because baffles are

Photograph Courtesy Pratt & Whitney Aircraft Division, United Aircraft Corporation

Visual-flow pattern of heat transfer from a finned cylinder at a Reynolds Number of 3550.

utilized which force all the air to pass through the fin spaces. Because of this latter difference, data on finned tubes in general do not apply. Details are given about tests carried out to establish the action of heat transfer in this case and to provide a generalization of the data useful for design. The work was carried out at the University of Delaware, in conjunction with a Pratt & Whitney Aircraft Division heat-transfer research program.

The experiments were conducted on a typical section of an aluminum-finned cylinder heated by an external electric heater. Temperatures were measured at the entrance and exit air stream and at eight points, equally spaced circumferentially, in the base metal. The results were interpreted by comparison with heat-transfer relations for flow inside conduits. The maximum heat-transfer rates were in close agreement with these relations although the average rates were lower owing to the decreased cooling-air velocities over the front and rear fin surfaces outside the baffled portion of the cylinder. The overall pressure drop is shown to be about double the estimated frictional resistance; the inlet and exit losses provide an explanation. *Transactions of the A.S.M.E.*, November, 1945, pages 601–612, 19 illus.

Carburetor Air Filters for Aircraft Engines. Richard S. Farr. Problems connected with the design of aircraft-engine carburetor air filters are discussed. Consideration is given to the filter problem created by dust conditions; the performance of ram-air-type installations and nonram installations as revealed by tests; and design and manufacturing problems connected with the production of efficient air filters. It is stated that desirable features for aircraft-engine filters are that they should be light in weight, durable in construction, high in efficiency, low in pressure loss, easily cleaned, and operated at velocities that cause the minimum of oil entrainment. In conclusion, the writer states that there is considerable room for the further development of filters and nonram intakes. *Mechanical Engineering*, November, 1945, pages 704–706, 2 illus.

Chrysler 16-Cylinder Airplane Engine. Brief particulars are revealed about a 16-cylinder inverted V-type Chrysler aircraft engine that has been under development for some time. The engine is liquid cooled and weighs 2,430 lbs. Major features include a small frontal area, two-piece crankshaft bolted together, two valves per cylinder, and a single-piece crankcase. Reference is made to flight tests of the engine installed in a redesigned P-47H fighter plane. *Automotive and Aviation Industries*, November 15, 1945, page 29, 2 illus.

The Rolls-Royce Derwent. James D. Pearson. A detailed descriptive analysis of the Rolls-Royce Derwent jet-propulsion gas turbine is supplied. It is noted that it was in April, 1943, that Rolls-Royce, Ltd., while continuing to supply Whittle units for test purposes in various aircraft, began designing the Derwent. Derwent units rendered their first service in fighter aircraft when the Meteor was used against the German flying bombs launched against England in 1944. Brief information is given about the extensive tests to which the units were subjected. The principle on which the engine operates is outlined. Details are given about the oil system and the fuel system.

Other sections are devoted to ground handling, flight handling, "trouble shooting," starting preparations, inspection and servicing, and maintenance and overhaul. Illustrations and diagrams reveal features of the fuel system, oil system, and other components of this jet engine. *Commercial Aviation*, October, 1945, pages 26–48, 26 illus.; "Rolls-Royce Derwent," *Flight*, October 25, 1945, pages 447–450, 4 illus.; "The Rolls-Royce Derwent B.37 (Series I) Jet Propulsion Unit," *The Aeroplane*, October 26, 1945, pages 477–480, 3 illus.; "The 'Derwent' Jet-Propelled Aero Engine," *Engineering*, November 16, 1945, pages 406, 407, 1 illus.

Effciency of Extended Surface. Karl A. Gardner. In this paper the work of previous investigators on heat flow through extended surface is briefly reviewed and references to published matter are given. General equations are derived for the temperature gradient and fin efficiency in any form of extended surface to which the assumptions listed are applicable. The solution of these equations in terms of Bessel functions is shown to cover practically any form of extended surface whose thickness varies as some power of the distance measured along an axis normal to the basic surface. Curves are presented for the fin efficiency of several forms of straight fins, annular fins, and spines. *Transactions of the A.S.M.E.*, November, 1945, pages 621–631, 9 illus.

An Analysis of Wear of Aero Engine Parts. W. N. Twelvetrees. Consideration is given to the causes of surface wear in the working parts of aircraft engines. Particular attention is paid to factors other than loading, which are the cause of wear in bearing surfaces. Most of the article is devoted to physical changes that cause wear but chemical reactions affecting wear are briefly summarized. An analysis is made of the causes of wear in piston rings, valves, wrist pins, gears, bearings, and other parts. *Aircraft Engineering*, October, 1945, pages 301–305, 308, 12 illus.

Flight Technique

Handling the Seaplane. George B. Post. Concluding half of a two-part article on operational techniques for water-based aircraft. Detailed advice is given as to special points that must be observed by the pilot of a seaplane on the take-off run; when landing; while taxiing in normal weather; and in maneuvering on the water during storm conditions. Special piloting methods that differentiate the handling of a plane with floats from that of a plane with wheels are noted. *Flying*, December, 1945, pages 30, 31, 78, 81, 82, 86, 90, 92, 5 illus.

Contact Is Safer. Lt. Col. James Herrick. Two axioms are indicated as being fundamental to the safe

RADIO COMMUNICATION FOR SMALL AIRPORTS

- *Complete station in one purchase*
- *Push-button controlled*
- *Experienced operators unnecessary*

The Aireon Type RS-1 radio station is a complete, self-contained, simple-to-operate unit, specifically designed to meet the requirements of a small airport. The transmitter is rated at 50 watts output and readily portable, and also makes an ideal emergency station. The type RS-1 radio station is also available with the proper frequency ranges for tower operation. ***Descriptive brochure with specifications FREE on request.***

Aireon MANUFACTURING CORPORATION

Radio and Electronics, Engineered Power Controls

FAIRFAX AND FUNSTON ROADS, KANSAS CITY 15, KANSAS

AV. CIPRES 64, MEXICO, D. F.

flying of a contact pilot. The first one is, that without proper instrument training or equipment he is not an instrument pilot and must stay out of the overcast. The second is, that if he starts where the weather is flyable and avoids places where unfavorable weather prevails he will not get into trouble. *Air Facts*, December, 1945, pages 36–42.

Watch That Stall. Russ Brinkley. Suggestions are offered for the performance and teaching of stall maneuvers. Twenty-six different types of stalls are considered. *Southern Flight*, November, 1945, pages 38, 39, 48, 80.

Fuels

Postwar Internal-Combustion Engines and Their Fuels. T. B. Rendel. The writer reviews the field of internal-combustion engines and their fuel requirements, together with the scope of refinery operations as they will exist for the next few years. He also discusses some of those problems that both the engine-building industry and the petroleum industry will have to settle cooperatively, such as detonation and its exact measurement, preignition, and the interpretation of laboratory ratings of octane numbers.

A section is devoted to the fuel requirements for spark-ignition aircraft engines. *SAE Journal*, November, 1945, pages 621–629 (Transactions), 6 illus.

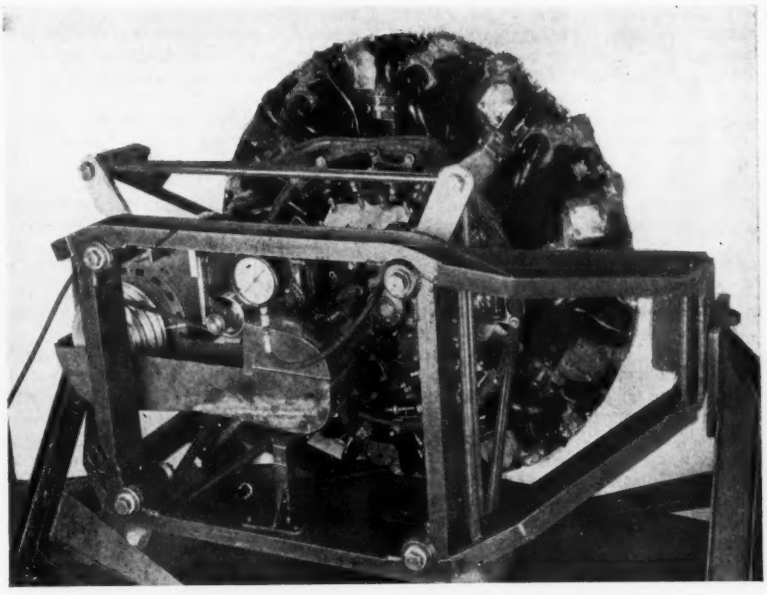
Gliding and Soaring

The First Freedom? Design, construction, and performance data are given for two small British sailplanes now under construction. One is the Chilton Olympia; the other, the Wanderlust. Dimensions, weights, performance, and load factors are tabulated. *Flight*, November 1, 1945, pages 476a, 476b, 2 illus.

Hydraulic Equipment

Aircraft Hydraulic Units. Part III. J. A. Oates. Details about Dowty Equipment Ltd., and the various hydraulic aircraft units they manufacture are continued in this third article of a series. Part III includes a review of the Dowty Levered Suspension System, a description of the electrohydraulic controls developed by the company, and a survey of the equipment and setup of the firm's Repair, Research, Drawing, and Standards Departments. Apprenticeship schemes for ensuring a steady flow of skilled workers into the Dowty factories are outlined.

Among the equipment described are a static-test rig, drop-test rigs, a cathode-ray oscillograph, jack-testing equipment, a low-temperature refrigerator, and flow-test apparatus. *Aircraft Production*, November, 1945, pages 544–552, 19 illus.



Photograph Courtesy Wright Aeronautical Corporation

A nine-cylinder "dummy" engine employed for determining radio-shielding qualities of aircraft-engine ignition system.

Inspection

Fluoroscopy of Light-Alloy Castings. B. Cassen and D. S. Clark. The investigation reported was undertaken at the California Institute of Technology for the War Production Board. It was carried out to determine more precisely the limitations of fluoroscopy for flow detection in light-alloy castings, the possibilities of improving this inspection method, and the possibilities of substituting fluoroscopic examination for radiographic methods in certain types of inspection. The investigation indicates that the fluoroscope using rotational scanning shows a surprisingly large number of medium and larger defects that are not detected radiographically. Included in the report is a description of a superior type of protective window to take the place of the conventional lead-glass window which discolors. *The Iron Age*, November 1, 1945, pages 54–59, 9 illus.

Spectroscopy Applied to Ferrous and Nonferrous Materials. Wm. J. Poehlman The use of the spectrograph in the control of welding and weld materials is described. It is noted that with the spectrograph accurate nondestructive analyses of metals, castings, and forgings, bar and plate stock, weldrod wire, and weld metal can be made with great economy and speed. A brief review of the origin and history of spectrography is provided. The spectrograph and other equipment used in the modern laboratory are illustrated. Some typical results obtained with this equipment are described. *The Welding Journal*, November, 1945, pages 564-s–572-s, 16 illus.

X Ray Standards for Purchasing Castings. Leslie W. Ball. The writer describes how agreement on castings to be accepted can be furthered by interpreting nonhomogeneities as revealed in radiographs according to the criticalness of the area in which they are located. Information is supplied about a method developed by the Lockheed Aircraft Corporation for distinguishing critical from noncritical areas for determining the acceptability of castings; and a method of preparing radiographic illustrations for critical and noncritical areas that has been developed in the laboratories of Triplett & Barton, Inc. *The Iron Age*, November 22, 1945, pages 62–64, 4 illus.

Instruments

Human Engineering and Instruments. Comdr. D. L. Hibbard. The greater part of this paper is given to a discussion of instrumentation in aircraft from the "human-engineering" point of view. Certain types of instruments for aircraft and other uses are criticized because of the difficulty in reading them and interpreting their indications.

As an example of poor human engineering, the writer refers to some of the present altimeters. He points out that as the altitude of aircraft has increased, the instrument has not been redesigned to provide a simple presentation, but instead it has been complicated by the addition of two more hands, so that one hand in one revolution indicates 1,000 ft., another indicates up to 10,000, and the third records higher levels. With three hands on one instrument dial it is stated to be virtually impossible for an ordinary man to glance at it and know his altitude.

In the opinion of the writer, other instruments could be improved from the standpoint of facility in use or in location or they could be eliminated by replacement with automatic devices. He suggests simplification of existing instruments and the development of others to relieve the pilot of many of his responsibilities. Among his suggestions for simplification is the substitution of pattern indication for quantitative figures, such as colored lights instead of specific numerals, consolidation and uniformity of instrument indications, and the possible employment of senses other than vision.

Special instruments for helicopters are suggested, as well as improved physical and psychologic means for conveying flight information to the pilot. *Instruments*, November, 1945, pages 760–763.

Instruments for the Private Flyer. Col. T. B. Holliday. An analysis of instrument requirements for low-cost private planes, made with a view toward establishing a median ground between the efficient but expensive instruments employed for combat aircraft and the low-cost instruments used by private fliers. The functions of different categories of flight instruments are explained and standards to which efficient instruments should be designed are outlined. These standards feature the requirements that the instruments be easy to read; the indication of the instrument be one that corresponds to natural instincts in causing pilot reaction; and that the panel consist of a minimum number of instruments for safe flying. The minimum instruments needed for contact flying are listed, as well as those required for instrument flying. With regard to cost, it is concluded that the sales price of a complete instrument panel for a $2,000 airplane should not exceed $100 to $150. *Flying*, December, 1945, pages 24, 25, 92, 96, 100, 4 illus.

Future Requirements for Instrumentation in Aviation. Major J. G. P. Callahan. Reference is made to the part played by the United States in advancing standards of aircraft-instrument quality and reliability. Eighteen future requirements for instrumentation in the aviation field, representing problems for research and development, are listed. *Instruments*, November, 1945, page 763.

Test Instruments. This is a survey of some of the aircraft test instruments and devices exhibited at Farnborough by the Royal Aircraft Establishment in collaboration with other M.A.P. establishments.

In the aerodynamic category, the instruments described include accelerometers, a Smith air-speed indicator having two pointers, the Kollsman G.1 air-speed indicator, Mach meters, a multicapsule manometer used for pressure plotting in flight, a trailing static instrument for the measurement of static pressure of the air without interference from disturbed airflow about the aircraft, a special Venturi-pitot device, and a wind-direction and velocity indicator incorporating a wind vane carrying a slotted spring plate.

In the gyroscopic category, the following instruments are among those mentioned: a rate-of-roll meter embodying a spring-restrained Schwein electrically driven gyro in conjunction with a standard Smith's micro-Desynn transmitter and receiver, to record rates of roll of fighter aircraft; control-force and movement indicators of various types; and a flying-control space-time recorder for measurement of control deflections and differential motion against a common time scale. Data are given about a system for investigating the transition of laminar into turbulent airflow over wings and propeller blades, and a special device for determining propeller efficiency.

Instruments shown in the structural section of the exhibition included strain-recording equipment, six-channel cathode-ray oscillograph recording equipment, and a device for indicating the strain distribution in propeller blades. *Flight*, October 11, 1945, pages 390–392, 6 illus.; "Aircraft Test Instruments," *The Aeroplane*, October 12, 1945, page 408, 3 illus.; "Aircraft Instruments," by Squadron Leader D. West, *Aeronautics*, November, 1945, page 53; "Instruments for Testing Aircraft," *Engineering*, November 16, 1945, pages 396, 397, 5 illus.

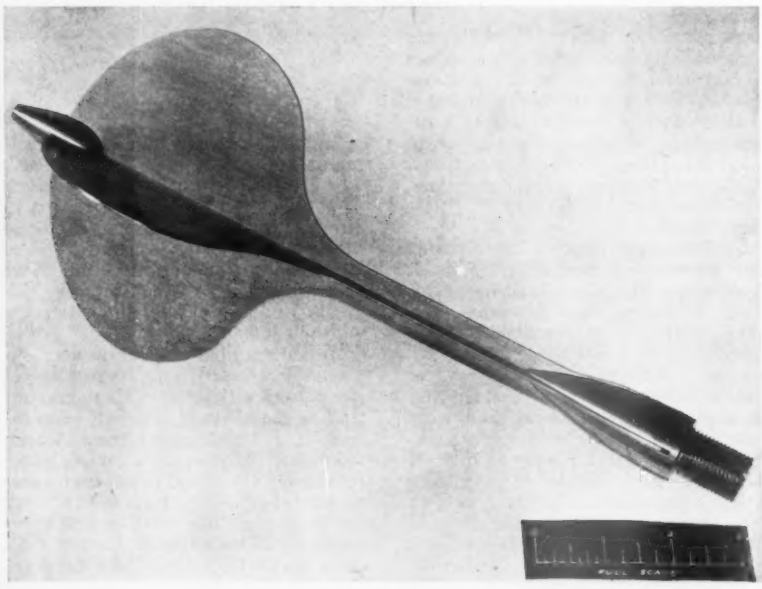


Illustration Courtesy Consolidated Vultee Aircraft Corporation

Tail assembly of trailing air-speed bomb designed to measure static pressure at speeds in excess of 300 m.p.h. The device has a static pressure head attached to one end and four stabilizer fins at the other end.

Lubrication

Significance of Grease Viscosity in Aircraft Lubrication. J. C. Zimmer and J. B. Patberg. The contributions of the techniques of lubrication to the improved performance of aircraft are reviewed, with particular reference to the use of petroleum greases in applications where oil lubrication would not be practical. Progress is reported in the simplification of specifications for greases, reducing to a group of four fundamental grades the great number of grades manufactured during the early years of the war to meet the ideas of various branches of the Army and Navy air forces, the producers of aircraft, engines, and equipment, and the refiners of lubricants. These four specifications have been found by experience to be suitable for practically all aircraft lubrication requirements.

The writer describes the properties of petroleum lubricating greases, analyzing the stresses to which greases are subject in service, and outlining the factors that affect greases. Methods of testing the viscosity and other properties of grease are explained. *Aero Digest*, November 1, 1945, pages 75, 76, 137, 138, 141, 4 illus.

Maintenance

Parts—How EAL Controls Them. William Frey. This is an account of the way Eastern Air Lines handles the complex problem of parts control. The method of cataloging and numbering parts is explained. Information is given about stockroom facilities and methods, parts inspection, the receiving department, shipping department, and toolroom. *Air Transport*, November, 1945, pages 32–38, 11 illus.

Ski Tips. Robert J. Whittier. Procedures are recommended for the maintenance, repair, installation, and inspection of airplane skis. Routines for checking skis before their use are outlined, with attention called to the

particular techniques that must be applied for each part of the ski. Special requirements for metal skis and for wood skis are noted. The advised procedures are designed to answer the needs of the average light-plane owner and pilot rather than those of the mechanic. *Air Facts*, December, 1945, pages 44, 45, 48–54, 1 illus.

Soft-Grit Blasting of Cylinders. J. Albin. Information is given about soft-grit processes for blast-cleaning airplane-engine cylinder heads, pistons, and other parts without damage to critical surfaces. Particular reference is made to soft-grit blasting tests conducted by American Airlines, Inc., which indicate that production can be increased by the use of coffee grains and other soft materials as a cleaning grit. It is stated that little alteration in available sandblasting equipment was required with this process, and that substantial production increases were attained with reduced man power. *The Iron Age*, November 22, 1945, pages 65–67, 3 illus.

Maintenance and Repair of Airplane Fabric. Gilbert C. Close. With pertinent suggestions as to kinds and qualities of fabrics, "dope" application, and workmanship, advice is given on how to recover or patch the fabric parts of airplanes. The recommended procedures are outlined under five different work stages: (1) selection of the proper fabric materials; (2) inspection prior to covering; (3) preparation for covering; (4) covering; and (5) doping. *Western Flying*, November, 1945, pages 48, 50, 52, 90, 4 illus.

Maintenance Problems Answered. Reference is made to an earlier invitation extended to air-line engineers to tell about their experiences with ten stated maintenance and overhaul troubles and to explain how they were meeting these difficulties. The replies received from four air lines are listed in tabular form. *Air Transport*, November, 1945, pages 42, 43, 1 illus.

New Overhaul Concepts. Lee J. Bregenzer. Consideration is given to problems involved in supplying additional overhaul facilities for air lines to take care of expanding commercial air transport. The writer describes plans for decentralized bases and standardized units for overhauling air-transport planes. It is explained that decentralization removes the major overhaul base from congested areas, while standardization in design units reduces the costs and time required for construction. Plans are shown for a decentralized unit base for major overhaul, a nose hangar, paint shop, and warehouse. *Aviation Maintenance*, November, 1945, pages 45–49, 110, 112, 114, 6 illus.

Conveyor Line for Engine Maintenance. An outdoor conveyerized run-up line for quick servicing of airplanes is described. As originated by North American Aviation, Inc., the conveyer line was used between the end of the final assembly hangar and the compass rose. Cowling for each plane was placed on individual dollies that moved with the planes. Fuel, oil, air, and electric power were available at appropriate points along the line, and cables were utilized to tie down the airplane during engine runs. Adaptation of this system for other aircraft maintenance purposes is suggested. *Aero Digest*, November 15, 1945, page 80, 2 illus.

Marketing

The Catalog—Envoy of the Product. E. A. Pinger. Based upon a questionnaire sent by the National Aircraft Standards Committee to 32 prime contractors of airplanes, a list gives the more obvious requirements to be fulfilled by a properly planned aircraft-equipment catalog in the order of their relative importance. Deficiencies necessitating improvements in methods of cataloging aircraft equipment are indicated, as are the purposes of a good catalog. *Aero Digest*, November 1, 1945, pages 59, 112.

Should Department Stores Sell Planes? Because of the current trend toward the sale of personal airplanes through department stores, a survey was conducted to determine the advantages and objections to this method of merchandising aircraft. The results of the survey are reported. Consideration is given to the effects of department-store sales on distributors, the volume of airplane sales, airport business, service operators, and downtown showrooms. *Aviation Maintenance*, November, 1945, pages 41–44, 8 illus.

Planning Service Operator Publicity. Robert L. Fli. The aircraft service operator is advised on methods by which he can promote his business through publicity and public-relations channels. Ideas are offered pertinent to selling block time on gift-certificate plans; placing straight news stories; promoting general good will; tie-ups with sports events; free flight instruction with the purchase of new planes; publicizing airport facilities; human-interest stories; merchandising of airplanes and aircraft accessories through department-store displays; providing speakers for social and cultural groups; and raffles. *Aero Digest*, November 15, 1945, pages 38, 39, 132, 1 illus.

Sell Airplanes Over the Counter. Sales connections with large retail department stores for the distribution of airplanes and aircraft parts are described as arrangements which will both facilitate the sale of aircraft on a long-range scale and be of benefit to the fixed-base operator. In a brief discussion of the value of such arrangements to the airplane industry, three basic types of contract between aircraft manufacturers and department stores are surveyed: (1) a straight dealership under a manufacturer's regular distributor; (2) the department store is made a subdealer; and (3) the department store works directly with the manufacturer, cooperating with established local dealers located at airports. *Aviation*, November, 1945, pages 110, 111, 3 illus.

Materials

Aging of 75S Aluminum Alloy. William L. Fink, J. A. Nock, Jr., and

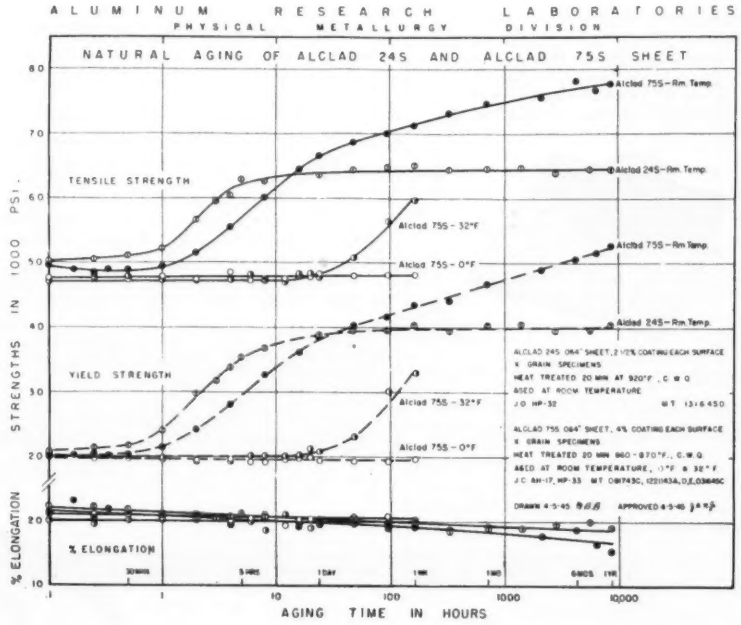


Illustration Courtesy Aluminum Company of America

Chart showing results of natural aging of Alclad 24S and Alclad 75S sheet.

Flight 5 and the helpful ghost

Send today for your FREE copy of "Report from AeroJet"—a factual story of immediate and vital interest to everyone in aviation.

AeroJet Engineering Corporation
285 West Colorado Boulevard
Pasadena, California

Shrouded in heavy fog, darkness and a beating rain—most flights cancelled. Take-off blind under such conditions is too great a hazard. Instrument lag and pilot reaction together amount to seconds . . . critical seconds badly needed for safety margin.

But there down the runway comes Flight 5—a ghost of whitish vapor swirling out behind her. She's run about 1500 feet. Suddenly the big plane rises sharply—with AeroJet take-off assistance—*a thousand feet sooner* than usual! Up and away, long before required . . . and carrying a heavier payload, too.

Interested in jet-assistance for your operation? Then write AeroJet today for information you've been wanting. It's in the factual booklet, "Report from AeroJet."

With Jet Assistance: Civil Air Regulations Take off Flight Path—2587 Ft.
Without Jet Assistance: Civil Air Regulations Take off Flight Path—4000 Ft.

DC-3 Analysis as Described in "Report from AeroJet"

THE POWER OF THE FUTURE... AeroJet

AEROJET ENGINEERING CORPORATION • AFFILIATE OF THE GENERAL TIRE & RUBBER CO

M. A. Hobbs. Particulars are given about aging treatments for 75S aluminum alloy. The effects of these treatments on the workability of the metal are discussed, with reference to the dimpling capacity, tensile properties, corrosion resistance, and the effects of cold-working after quenching and before aging.

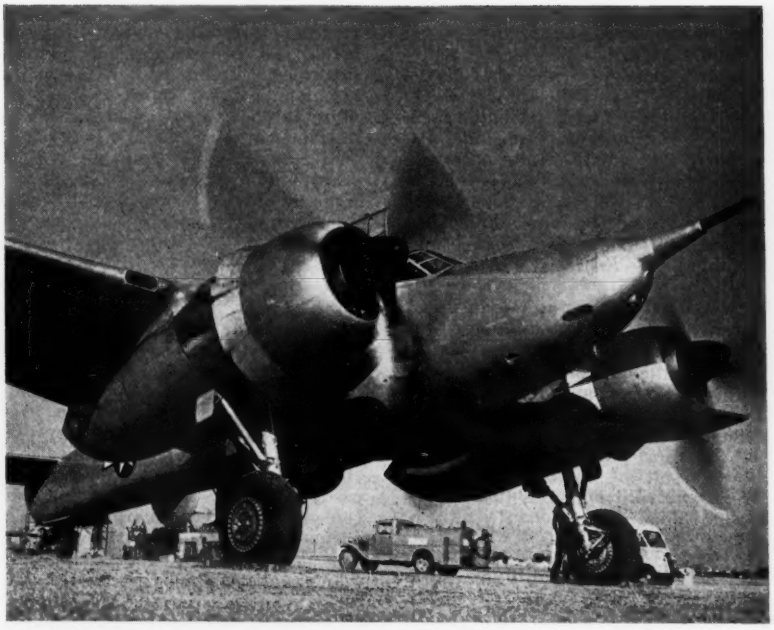
The paper describes the properties of 75S which are attainable by room temperature aging, and by artificial aging at constant temperature or at a plurality of temperatures (that is, by a new procedure known as "interrupted aging"). In the absence of cold-work, 75S aged by the interrupted procedure (consisting of heating 4 hours at 210°F., cooling to room temperature and then heating 8 hours at 315°F.) has tensile properties closely approximating those of 75S aged for 24 hours at 250°F.; a resistance to corrosion equal to, or slightly better than, that of 75S aged at the constant temperature; and a substantially better dimpling capacity. The interrupted-aging procedure has the additional advantage of requiring considerably less furnace time.

The principal disadvantage of the interrupted-aging treatment finishing at 315°F. is that it produces substantially lower strengths in material cold-worked after quenching than does a constant-temperature aging of 24 hours at 250°F. (about 1,000 lbs. per sq.in. lower for each per cent of permanent elongation). *The Iron Age*, November 1, 1945, pages 64–67, 6 illus.

Medicine

Sodium Amytal Narcosis in Management of Emotional Disorders of Combat Flyers. Capt. Howard R. Erb and Major Douglas D. Bond. This report extends and modifies earlier impressions regarding the use of deep sodium amytal narcosis in the treatment of certain emotional disorders of combat fliers as recorded by Hastings, Glueck, and Wright. Sections are given to the method of treatment, standards of evaluation, and the results of the treatment. The conclusions are summarized. *War Medicine*, September, 1945, pages 146–152, 4 illus.

Emotional Albuminuria in Returned Flying Officers. Capt. Herbert R. Plass. In a series of studies of the cases of 935 flying officers returned from combat it was found that 49 had albuminuria of variable severity which could not be ascribed to organic disease. Fifteen min. after withdrawal of blood for a Kahn test, 160 of the officers were found to have albumin in the urine. One hundred and eleven of these men had had clear urine before the venipuncture. Officers hospitalized for operational fatigue tended slightly to have more frequent and more severe albuminuria than those sent to duty. It is concluded that emotional albuminuria probably should be regarded as a single one of many signs and symptoms of a person's autonomic activity under conditions of decompensation. *War Medicine*, September, 1945, pages 153–155.



The Beechcraft XA-38 attack airplane, designed to carry a 75-mm. automatic cannon, mounted in the nose, in addition to six 0.50-cal. machine guns.

Metallurgy

The Examination of Four Samples of Early Aluminium Alloy Sheet Metal. K. J. B. Wolfe. Results of an examination of four samples of early aluminum alloys taken from heavier-than-air craft are reported. One sample was of British origin, being part of a naval airship named the "Mayfly," built in 1909–1911. It is stated that the alloy was a true duralumin-type, although produced at least 2 years before the discovery of age-hardening, and that the quality was extremely poor.

Three samples came from the German Zeppelin L.33, which was brought down in Essex in 1916. It is stated that these alloys were also of true duralumin-type and appeared to have been used in the heat-treated and aged condition. The metallurgic condition of one sample was poor but the quality of the other two compared favorably with that of modern-type alloys. *Sheet Metal Industries*, November, 1945, pages 1943–1950, 1958, 13 illus.

Military Aviation

Air Co-Operation in Mountain Warfare. Lt. Col. F. S. Smythe. With the comment that, in any major European war, operations are certain to take place amid high hills and mountains, this British writer discusses air squadrons equipped to co-operate with ground formations fighting through the mountains. To provide an understanding of the problems involved, he describes briefly the nature of mountain warfare under present-day conditions. Consideration is given to the ideal type of aircraft for mountain warfare. Information is given about the part aircraft can play in the supply of forward areas, photography, search and rescue, the locating of enemy troops, and artillery cooperation. *Aeronautics*, November, 1945, pages 24–27, 4 illus.

Hermann's Hindsight. David C. Cooke. A series of observations and explanations which were made by Hermann Goering in reply to Allied interrogation officers are reported. These pertain to Nazi principles of air power, the course of development and retrogression followed by the Luftwaffe, and some of the reasons for the defeat of the German air force. Such questions were asked as why there was a delay in the use of the Me 262 as a fighter; why the Germans bombed cities in England instead of concentrating on aircraft and engine factories; why there was a change-over in German productive power from offensive to defensive aircraft; etc. The Luftwaffe's defeat is attributed mainly to improper planning, indecision of its leaders, and the strategic bombing by the Allies of German manufacturing facilities, oil refineries, and marshalling yards. *Air Trails*, December, 1945, pages 29, 60, 62, 3 illus.

Naval Aviation

The Merchant Aircraft Carrier "Empire Macalpine." Details are

given about the design and construction of the merchant aircraft carrier "Empire Macalpine," which is representative of a type of ship that played an important part in the Battle of the Atlantic. The principal dimensions of the hull and propelling machinery are listed. Information is given about the aircraft accommodations, crew accommodations, deck machinery, and the four-cylinder opposed-piston oil engines that propel the ship. *The Engineer*, November 9, 1945, pages 365, 366, 5 illus.

"A Capital Ship for an Ocean Trip." Arthur Krows. A tabulation of the capital warships lost in World War II is offered in support of contentions that aircraft and aircraft carriers are a mainstay of modern navies. It is demonstrated that more than half the ships lost were immobilized as a direct result of combat air power. *Aero Digest*, November 1, 1945, pages 38, 39, 1 illus.

Paints and Coatings

Performance and Structure of Anodic Coatings on Aluminum. F. Keller and Junius D. Edwards. It is stated that many significant relationships can now be found between the structure of anodic coatings on aluminum and some of their important characteristics, such as protection against corrosion, wear resistance, and adsorptive powers. The structure of these coatings and factors affecting their serviceability are analyzed. The results of various tests are described. Reference is made to the popular idea that anodic coatings on aluminum are merely a strengthening of the natural oxide film. It is shown that actually anodic films are considerably different from the natural film in many of their properties. Electron micrographs of oxide coatings are reproduced. *The Iron Age*, November 22, 1945, pages 75–78, 9 illus.

Combined Anodizing—Chromatizing. G. A. Studer. Problems involved in installing efficient anodizing and chromatizing equipment at the plant of the Hughes Aircraft Company are studied. It is pointed out that both processes employ the same chemical bath and produce approximately the same results, but with chromatizing no electric current is used. Factors that determine the choice of the particular process are outlined. They include the composition of the metal; the complexity, shape, and size of the work; and plant facilities. Details are supplied about the layout of combined anodizing and chromatizing equipment at the Hughes plant. *Automotive and Aviation Industries*, November 1, 1945, pages 32–34, 85, 86, 88, 4 illus.

Personnel

The Merchant Air Crew. Parts II and III. Erik Nelson. The second installment of a three-part article on the requirements, selection, training, and employment of flight personnel for transport aircraft considers the four types of transport operations previously discussed in relation to the crew carried and their accommodations. The multiple-crew system is examined and the opinion is offered that such a system is uneconomical. Functions of telegraphists and flight engineers are noted, with advice offered as to the type of aircraft and trips on which the services of such personnel would be advantageous. A suggested standard control-deck layout is described in detail.

Part III recommends qualifications, grading systems, and licensing methods for the Captain, First Officer, Second Officer, Third Officer, telegraphists, flight engineers, commercial crew, operational crew, and "services" crew. The concluding portion of the article deals with necessary inspections for ensuring safe operation, medical reexaminations of air crews, and conversion courses for air crews recruited from the fighting services. *The Aeroplane*, October 12, 1945, pages 429–431, 1 illus.; October 19, 1945, pages 457, 458.

Plastics and Plywood

Low-Pressure Laminate Forming—Design Data and Applications. W. H. Arata. The advantages of aircraft parts formed from laminated phenolic sheet are enumerated. Vendor materials suitable for forming are listed. Information and design data are supplied about types of molds. Methods of heating sheets prior to forming, minimum bend radiuses on parts, and methods of fastening phenolic parts are described. *Product Engineering*, November, 1945, pages 753–755, 3 illus.

How to Work Transparent Plastics. Particulars are given about ways to form, cut, and maintain transparent plastics for airplane applications. Illustrations show the methods of procedure. *Aviation Maintenance*, November, 1945, pages 50, 51, 106, 108, 110, 16 illus.

Private Flying

Know Your Operating Costs. Neil M. Berboth. A definite method is suggested for determining the operating expenses of any given light aircraft over a given period of utilization. The formula is worked out mathematically but reduced to its simplest terms the recommended method is this: Add fuel and oil costs per hp.-hr. ($0.0243) and maintenance cost per hp.-hr., which varies with the age of the airplane. Multiply this sum by the cruising horsepower of the airplane. Then multiply the answer by the number of hours flown per year. Add to this total the annual hangar rental cost,

Right on the Nose of the NEW Ercoupe

Again Ercoupe chooses Sensenich as standard equipment ... because Sensenich—world's largest manufacturer of wood aircraft propellers—knows how to design and build for maximum efficiency. Swing a Sensenich and be sure!

Prompt repair service now available.

Standard of Performance

SENSENICH AIRCRAFT PROPELLERS

SENSENICH BROTHERS

LANCASTER, PA. GLENDALE, CALIF.

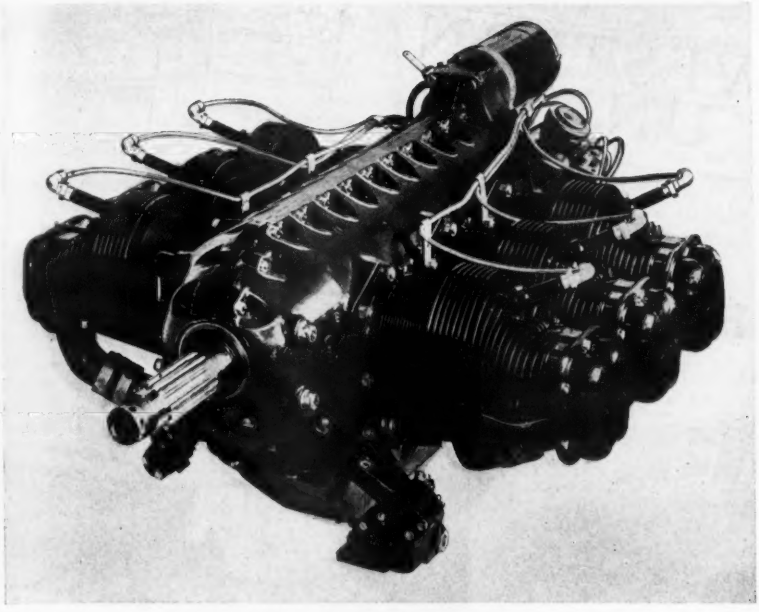
AIRCRAFT EXECUTIVE

TO TAKE FULL CHARGE OF ALL MATERIEL FUNCTIONS: PURCHASING, STORES, CONTROL, MATERIEL, ESTIMATING, ETC.

MUST HAVE AT LEAST 5 YEARS AIRCRAFT EXPERIENCE IN SIMILAR CAPACITY

EXCELLENT OPENING IN MIDWEST AIRCRAFT MANUFACTURING FIRM

Write Giving Full Details To Box 437



The Continental Model A-100 six-cylinder airplane engine, many of whose parts are interchangeable with those used in the manufacturer's Model A-65 engine.

which is the number of passenger seats multiplied by $90 (in the absence of a specific cost); depreciation, which is the selling price of the airplane multiplied by 0.135; and the insurance cost. To get insurance cost add $45 to the sum of the number of passenger seats multiplied by $17.50, and to the sum of $0.125 multiplied by the insured value of the airplane.

The article also contains a brief analysis of the factors that have a controlling influence upon operation costs. Although the cost-determining calculations refer mainly to personally owned light aircraft, it is stated that they are applicable to company-owned planes with a slight variation in the formula. Charts and tables supplement the calculations. *Aviation*, November, 1945, pages 106–109, 2 illus.

Winter Flying in Lightplanes. Albert E. Pacini. Private pilots are advised on special flight techniques and maintenance measures to be followed for operating airplanes under winter conditions. Among the recommendations are suggestions for facilitating starting and warming up the engine; taxiing; taking-off; and landing. *Skyways*, December, 1945, pages 32, 33, 70, 2 illus.

Production

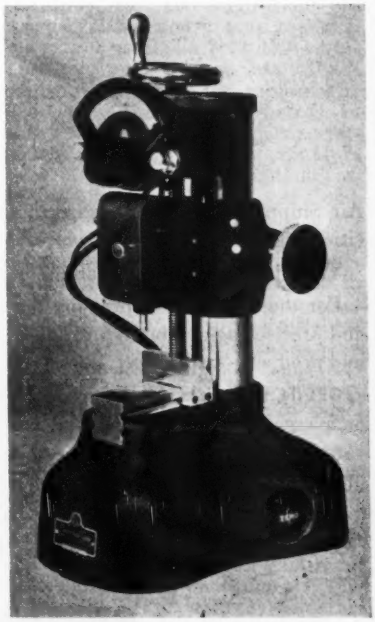
Centrifugally Cast Aircraft Parts. J. F. B. Jackson. This article deals with the application of centrifugal casting methods to irregular and asymmetric units in high-tensile alloy steel, with particular reference to aircraft-engine cylinders and air-frame parts. Beginning with an account of how the application of centrifugal casting to such units was developed, it goes on to detail the exact procedures by which the components are cast. The article also explains how manufacture of the components are controlled technically, describes the properties of centrifugal steel castings, and discusses some of the postwar applications of these products which may be expected. *Aircraft Production*, November, 1945, pages 511–513, 8 illus.

Exhaust Valve Has Special Design and Manufacturing Features. Warren H. Carhart. Information is given about a process for upsetting or gathering steel, used by Thompson Products, Inc., in the manufacture of exhaust valves made of two materials. It is applied also to certain other parts, including aircraft-engine exhaust manifold flange connections. Illustrations show several sizes of electric gathering machines, and the principle on which they operate is explained. Advantages of the forging process are outlined. *Steel Processing*, November, 1945, pages 687–690, 8 illus.

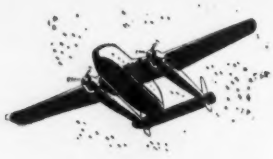
Stretch-Forming Plus Impact Banishes Joggling Problems. Douglas Hodges. A new type of stretch operation, which combines impact with stretch forming, is described. Developed by the Douglas Aircraft Company, the process depended upon the devising of a stretch die with a male punch and jaws that operate under the single action of a Toledo draw press. It utilizes a special attachment to the punch press, prevents irregularities, and permits closer tolerances in formed and extruded sections after bending, and is reported to have reduced rejection of these critical parts to 1 per cent. *Aviation*, November, 1945, pages 147–149, 4 illus.

Steel Castings Replace Forgings. E. B. Bromhead and T. E. Piper. The use of alloy steel castings in place of drop forgings for aircraft structural members is discussed, with particular reference to the experience of Northrop Aircraft, Inc. It is explained that alloy steel castings, generally considered unreliable from a quality standpoint, have proved highly efficient as structural members by virtue of their high strength-weight value, when made to aircraft quality standards. The results of experiments in the use of steel castings for aircraft structural members are described. Particulars are given about the requirements for steel castings for aircraft. *The Iron Age*, November 1, 1945, pages 50, 51, 2 illus.

Hawker Tempest. Part I. Wilfred E. Goff. Beginning a two-part study of the processes and equipment with which the Sabre and Centaurus versions of the Hawker Tempest are manufactured, this article traces the development of the Tempest. It presents general design and construction information, followed by details of the procedures involved in the production of the spars. Numerous drawings and photographs are shown of the airplane, its components, manufacturing equipment, and production methods. *Aircraft Production*, November, 1945, pages 517–529, 31 illus.



The Electrolimit external comparator manufactured by Pratt & Whitney Division of Niles-Bement-Pond Company, used for rapid inspection work.



*By Flying Boxcar

Air Shippers have their eyes on inland ports—the small cities with limited length runways.

Their interest turns naturally to the Fairchild "Packet."

For the "Packet"—expressing the painstaking research and precise engineering typical of *all* Fairchild operations and products—can:

GET IN, fully loaded with up to nine tons of flying freight, on average and less-than-average length runways.

UNLOAD AND LOAD, swiftly, with a minimum of manipulation. The "Packet's" split-tail doors at the rear open up the entire width of the boxcar-like fuselage. The forward cargo door permits quick access to "up front" freight. The "Packet's" horizontal cargo floor is at truck-floor height.

GET OUT, fully loaded, with a short run. It has take-off characteristics highly exceptional for a plane of its large cargo capacities.

All these characteristics are invaluable to the shippers seeking to tap the rich markets of the interior. They are characteristic of the "Packet" alone among cargo planes, because the "Packet," from its conception, was designed and built *specifically* to carry cargo—efficiently and economically—anywhere! They are the Fairchild "touch of tomorrow" in this plane of today!

Cargo operators—write for details about the "Packet."

Fairchild Aircraft

Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland

Fluxing Molten Aluminum with Dry Nitrogen. P. M. Hulme. How nitrogen fluxing is now being used in producing aluminum casting ingots and melting scrap is described. Sections are given to the effect of gas fluxing; the method of introducing nitrogen into the melt, which is the same as that used for chlorine; the use of nitrogen fluxing in reverberatory furnaces; nitrogen aids in alloying; and fluxing scrap aluminum. *Materials & Methods*, November, 1945, pages 1435–1438, 3 illus.

Estimating Die Costs. Ralph Howell. Details are given about methods employed by a large drop-forging company for estimating the costs of forging dies. The system is designed to avoid inaccuracies in estimating die costs caused by faulty records and inefficient recording procedure. Cards and forms used with the system are illustrated. Sections are devoted to a study of the information required; die casting records; and die maintenance and replacement records. *The Iron Age*, November 29, 1945, pages 44–48, 4 illus.

Standardization Tomorrow? B. C. Boulton. Engineering management, particularly in the aircraft industry, is urged to lend more active support to the general trend toward standardization. Examples are given indicating the extent of the improvement in product quality and the "cash dividends" that have accrued through standardization. Certain important developments in standardization work are noted and suggestions are offered which should make efforts in this direction more effective in the future. *Mechanical Engineering*, November, 1945, pages 729–734, 4 illus.

Forging Aluminum Aircraft Pistons on Mechanical Presses. Charles O. Herb. Details are given about a method of forging aluminum-alloy pistons for Pratt & Whitney aircraft engines developed by the Buick Motor Division of General Motors Corporation. The method differs greatly from the upset method usually employed. It involves the use of a forging press of 2,000-lbs. capacity. Consecutive steps in the manufacturing procedure are described. *Machinery*, November, 1945, pages 149–152, 5 illus.

Quality Control. H. Howell. A report is made on two methods of dimensional quality control—one employing "Go" and "Not Go" limit gages, the other based on the use of precision measuring instruments. Principles and procedures of both methods are explained in detail, and their advantages and disadvantages are compared. *Aircraft Production*, November, 1945, pages 539–543, 5 illus.

Propellers

Constant Speed Propellers for Lightplane Efficiency. Jesse Jones. With particular reference to Aeromatic propellers, the applications and advantages of the fully automatic variable-pitch propeller for light planes are investigated. Consideration is given to the operating principles, flight characteristics, weight, service, and maintenance of this type of propeller. *Southern Flight*, November, 1945, pages 40, 41, 2 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Automatic Synchronizers for Aircraft Propellers. Details are given about the Curtiss Automatic Synchronizer and reverse-thrust control for aircraft propellers, as applied to the B-32. It is stated that this was the first large landplane to be equipped with a combined synchronizer and reverse-thrust control. Descriptions are given of the construction of the master unit and its operation, the reverse-thrust mechanism, the alternator, motor, governor, and other control equipment. Illustrations show the complete master unit, the way the master unit is installed on the plane, a sectional view of the alternator, and components of the master control linkage. *Industrial Aviation*, November, 1945, pages 31, 32, 62, 5 illus.

Propeller Balancing Problems. Stanley G. Best. The writer discusses types of propeller unbalance, the amounts of each type of unbalance, factors contributing to unbalance, and methods of unbalance control. Consideration is also given to airplane-performance roughness caused by propeller unbalance. A study is made of human susceptibility to such vibration. It is concluded that airplanes do not give rough performance because of propeller unbalance unless either the structures or the engine-mount combinations exhibit resonant characteristics. Since structural frequencies are not susceptible to close control, it is believed that proper engine-mount design is of prime importance in eliminating propeller unbalance roughness. *SAE Journal*, November, 1945, pages 648–659 (Transactions), 11 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Coupled Engine Torsional and Propeller Flexural Vibrations. Capt. J. Morris. An analytic method is given for the determination of coupled engine torsional and propeller flexural vibrations, in which account is taken of blade section, blade twist, hub moment of inertia, pitch-setting angle, and speed of rotation. The propeller blade is divided chordwise into six portions which are regarded as having their masses concentrated at their centers of gravity, while account is taken, so far as is possible, of the actual elastic properties of the blade.

Application of the theory to a three-bladed propeller used on two different engines reveals satisfactory agreement between the calculated critical speeds and those observed experimentally on the cable hanger. The calculated fixed root frequencies for the fundamental and six overtones accorded closely with the corresponding values evidenced on a 1/10 scale model of the blade by bowing and calibrated oscillator tests. *Proceedings of the Institution of Mechanical Engineers*, Vol. 153, 1945, pages 41–56, 10 illus.

Radio

R/T or W/T. Owen Williams. A comparison is made of the suitability of radio telephony with that of radio telegraphy for communication between airplanes and ground stations. The writer indicates that the voice-communication system has disadvantages in Europe because of the many languages used, whereas in America that handicap is not so important. He reviews the points in favor of the telegraphy method, including the use of the Morse Code, which is advantageous because it is a universal mode of communication, and because of the mechanical efficiency of telegraphic methods in comparison with those used in voice communication. He gives typical examples of a radio-telephone communication between the ground and an airplane coming in for a landing, as contrasted with what he considers the more rapid and more accurate telegraphic method. On the other hand, the advantages of voice communication are given credit. *Aeronautics*, November, 1945, pages 76, 79.

A Very-High Frequency Aircraft Antenna for the Reception of 109-Megacycle Localizer Signals. Bruce E. Montgomery. An instrument landing system is briefly reviewed in an endeavor to show where the localizer antenna fits into the overall scheme. The localizer-antenna requirements

are stated and definitions that apply to this antenna are given. A description of an antenna that meets the specified requirements is given, including curves that show its performance. Patterns taken in flight on a twin-engined transport plane are included, to show the relative strength of the signals received when the airplane was flying at specified distances and directions from the transmitter and at specified angles of bank. *Proceedings of the I.R.E.*, November, 1945, pages 767–772, 11 illus.

"Calling All Towers." W. W. Ward. Instructions are given for the proper phraseology to be used in radiotelephone communication between an airplane and the signal tower or range station. Not only is the Restricted Radiotelephone Operator told what to say and when to say it, but he is also advised as to the actual operation of the small personal-plane transmitter. *Air Facts*, December, 1945, pages 55–62.

Radio Altimeter; Rescue Beacons; Collision Warning Indicator. S. S. Stevens. Another in a series of articles dealing with technical aspects of radio communication in air transport in Canada. The principle on which the radio altimeter operates is outlined. The applications of the radio altimeter to pressure pattern flying and the characteristics of an altimeter for this use are discussed. The requirements for rescue beacons and a collision-warning indicator also are considered. *Commercial Aviation*, October, 1945, pages 72, 119.

A Proposed Standard Dummy Antenna for Testing Aircraft-Radio Transmitters. Chandler Stewart, Jr. A description is given of a new type of dummy antenna employing a 35-ft. roll of coaxial cable and a power indicator. This antenna roughly simulates the impedance characteristics of an actual aircraft antenna for use over the frequency range from 2 to 30 megacycles. Its impedance characteristics are not appreciably affected by mechanical shock, humidity, aging, etc. With this antenna, power measurements can be made over a wide impedance range with a single indicating instrument. The impedance presented to the transmitter terminals is unaffected by lead geometry, ammeter impedances, etc. Its power-dissipating capability is limited by the flow temperature of the cable dielectric, and is of the order of 125 watts. *Proceedings of the I.R.E.*, November, 1945, pages 772–777, 10 illus.

Radio Interference Testing of Aircraft Engine Ignition Systems. John K. Rudd and Westcott Heath, Jr. An account is given of methods and equipment used at the Paterson plant of the Wright Aeronautical Corporation for studies of radio interference caused by aircraft-engine ignition systems. Details are supplied about the test room, which is shielded against radio-frequency radiation from industrial equipment and is used for the study of the radio-shielding qualities of ignition systems. A dummy engine for evaluating the radio-shielding qualities of the complete aircraft-engine ignition system is described.

Particulars are given about devices developed for determining the effectiveness of ignition-shielding joints, and other devices for special-purpose testing. The method used for determining the radio-shielding ability of ignition harness conduits is explained. The results of radio-frequency noise penetration tests conducted on five different designs of shielding conduit are enumerated. *Industrial Aviation*, November, 1945, pages 14, 16, 18, 19, 10 illus.

A portable "beach umbrella" type of antenna, used in connection with radar equipment, weighs only 400 lbs.

Reaction Propulsion

The Flying-Submersible. Robert D. Wolcott, Sr. Problems involved in the design of a "flying-submersible" are outlined, with particular reference to a craft that could maneuver for short distances at a limited depth under water with little applied power, and thus retain most of its fuel for air-borne operations. A brief description is given of the prototype flying-submersible known as the Wadru, which was introduced to the Navy Bureau of Aeronautics in 1943 and later in a revised form to the Army Air Forces Air Technical Service Command. The possibilities of applying rocket or jet thermal units to such craft are considered. *Journal of the American Rocket Society*, September, 1945, pages 10–12, 2 illus.

The Early History of the Whittle Jet-Propulsion Gas Turbine. Parts I, II, and III. Air-Commodore F. Whittle. The initial James Clayton Lecture of the Institution of Mechanical Engineers, established in memory of the late James Clayton, who provided an endowment for the encouragement of mechanical research, was given by Air Commodore Frank Whittle. The article contains the text of the lecture. The lecture begins with a general outline presenting the history of the development of the jet propulsion gas turbine since 1928, when the writer first gave it thought while a Flight Cadet at the Royal Air Force College. He gives the sequence of events, noting that it is sometimes necessary to compress the record of the work of months into a few sentences, and describing in as much detail as possible the work performed, with frequent mention of the assistance rendered by the writer's associates. The contributions made by numerous British manufacturers of

aircraft, engines, and equipment are explained. The design and testing of the experimental engine are recounted, with tabulated data, charts, and drawings of component parts of the engine.

The second installment of the article gives the details of the design and testing of the second and third models of the engine, illustrated by charts and photographs of the unit and its various parts.

The third installment continues with a description of the design and testing of the W1X and the W1 engines, followed by brief notes on the W1A, W2, and W2B engines.

Brief remarks refer to the progress made by the Germans in reaction-propulsion engines, and in a final paragraph an estimate is made of the future use of gas turbines for aircraft propulsion. The opinion is offered that within the next 10 to 15 years the gas turbine in its various forms will have a preeminent place in all aircraft with the possible exception of the light airplane, and its use is expected to be expanded to fields other than those connected with aircraft, especially in marine propulsion, industrial plants, and locomotives. *The Aeroplane*, October 19, 1945, pages 445–448, 451, 452, 14 illus.; November 2, 1945, pages 503–507, 15 illus.; November 9, 1945, pages 543–546, 14 illus.; "Early History of the Whittle Jet Propulsion Gas Turbine," by Air Commodore Frank Whittle, *Flight*, October 11, 1945, pages 309–311, 8 illus.

Atomic Powered Rockets. Cedric Giles. Atomic energy for rocket applications is briefly discussed. Consideration is given to the use of atomic energy to increase the destructive power of the warhead and to improve the propulsive energy of the fuel. *Journal of the American Rocket Society*, September, 1945, pages 5, 20.

De Havilland Goblin. Features of the turbine-jet unit for the de Havilland Vampire are recorded. Following a brief review of the unit's general specifications, its background development, and the tests to which it was submitted, the article gives particulars about its main components. Among the parts detailed are the air compressor, the combustion chambers, and the auxiliary services. Diagrams and photographs illustrate the design and construction characteristics of the Goblin. *Flight*, November 1, 1945, pages 472–474, 7 illus.

General Theory of Reaction Propulsion. Zygmunt Fonberg. Definitions and mathematical formulas that apply to rockets and thermal-jet engines are detailed. Definitions are given for the terms used in the text, and formulas regarded by the writer as logically and mathematically correct are explained. Formulas that differ greatly from those given by the writer are criticized. *Journal of the American Rocket Society*, September, 1945, pages 2–4.

Contemporary Jet-Propulsion Gas Turbines for Aircraft. D. F. Warner and E. L. Auyer. New horizons for the aircraft designer introduced through the advent of the jet propulsion gas turbine are outlined. The fundamentals of jet propulsion gas turbine design are briefly reviewed. A mathematical analysis is made of jet propulsion power-plant performance.

Performance curves are shown which are stated to be based on assumptions that are practicable and attainable today. A drawing reveals the details of a hypothetic jet propulsion power plant. *Mechanical Engineering*, November 1945, pages 707–714, 11 illus.

Research

A German Research Station. A report on the organization, facilities, and operations of the Luftfahrtforschungsanstalt (L.F.A.) at the Hermann Goering Institute at Voelkenrode. Particulars are given about this German research establishment's Institutes for Aerodynamics, Gas-Dynamics, Weapons Research, Theoretical Ballistics, Special Engines, Engine Research, and Statics. Included in the information are data pertinent to the site, purpose, cost, equipment, instructors, and employees of the L.F.A. *Aircraft Production*, November, 1945, pages 530–534, 9 illus.

Rotating Wing Aircraft

Principles of Rotary Wing Aircraft. Part VII. Alexander Klemin. The seventh part of a continued article deals with the mechanical problems involved in the flapping and feathering of the rotor blades to effect forward flight, and the type of mechanism used to produce those motions. In explaining the methods by which these motions are achieved and the formulas by which the forces are calculated, the writer introduces additional definitions and mathematical notations, and proceeds to examine the relationships that exist between the angle of incidence, the coefficient of thrust, and the ratios of tip speed and disc flow. The important physical facts concerning the induced velocity and the flow through the rotor disc that became apparent from these equations are summarized, as well as other points regarding the relative velocity and the angles of attack at the blade element.

Before studying the dynamics and aerodynamics of flapping, a discussion is given of the elementary principles of equilibrium involved in coning. Three equations are derived, the results of which are expressed in simple language as follows: (1) The angle of coning, when there is no oscillation about the flapping hinge, is proportional to the ratio of the thrust per blade to the centrifugal force acting on one blade. (2) The shear at the root of the freely hinged blade in a steady coning condition is apt to be quite small. (3) If the shear is quite small, then the weight of the rest of the helicopter is really supported by the vertical component of the tension in the blade. (4) The tension at the root of the blade is equal approximately to the total centrifugal force acting on the blade.

The two accelerations experienced by an element of the blade are explained, these being the acceleration at right angles to the plane of rotation and the acceleration attributable to the Coriolis Effect. The computation of the dynamic forces and moments produced by the accelerations induced by flapping is the next problem, of which an example is given, with and without consideration of inertia effects.

Eight examples illustrate the principles expounded in the current installment. *Aero Digest*, November 1, 1945, pages, 50–53, 122, 125, 126, 128, 129, 10 illus.

Flying Pogo Stick. Lt. Col. Lane W. Smith. Some notes on the peculiarities of piloting an R-6A helicopter. The impressions and suggestions are those of the flying-safety officer of the Air Transport Command's Ferrying Division, who indicates some of the handling problems encountered by the experienced airplane pilot just learning to fly a helicopter. *Western Flying*, November, 1945, pages 39, 90, 1 illus.

Wilford Gyrocopter Pointed Up as "The DC-3 of Rotor Wing Aircraft." Brief information is given about a projected design for a rotor-wing aircraft, the WT-22-80 Gyrocopter. This 22-place transport aircraft is designed to seat 12 passengers in the front and eight passengers in the rear of the engine compartments, plus a crew of two. It will have a maximum speed of 150 m.p.h., a cruising speed of 120 m.p.h., a 3-hour range, and a pay load of 4,500 lbs. *Air Transportation*, October, 1945, page 47, 1 illus.

Stress Analysis

Spanwise Air-Load Distribution. Leon Z. Seltzer. This paper presents a simple method for the determination of the spanwise air-load distribution over plain and twisted wings with straight taper. This method is based on the assumption, made by Schrenk, that for untwisted wings the lift distribution is proportional to a fic-

PERSONAL plane salesmen have a powerful, convincing story on all-metal, aluminum construction. Low up-keep cost, more maintenance-free flying hours, greater re-sale value and high factors of safety are points airplane buyers will spark to.

Alcoa has the alloys to support those sales points in every detail. In addition, these alloys offer lightness and strength, sleek and swift appearance—and public acceptance as a highly airworthy material.

Alcoa Aluminum Alloys have done yeoman service on our warplanes. Let our engineers help you determine where you can use these alloys to best advantage in your personal planes. For this information simply write ALUMINUM COMPANY OF AMERICA, 2142 Gulf Building, Pittsburgh 19, Pennsylvania.

"All-metal construction, from prop to tail feathers... Alcoa Aluminum, of course!"

ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM

titious chord which is the arithmetic mean of the actual chord distribution and the corresponding chords of an ellipse of equal area. For twisted wings this theory is combined with the changes attributable to rotation of the zero lift lines of each section.

This method for the determination of the spanwise air-load distribution makes it possible to complete this work in a fraction of the time required by the Lotz Method. Where possible the equations are presented in the same form used in ANC-1.

The results are given in coefficient form for ease in application to the stress-analysis problem. Because of the time saved, new fields of investigation are opened to the designer. The author states that by the use of the method it should be possible to investigate the effect of changes in plan form and airfoil shape on the weight of the wing structure.

The section lift coefficient is made up of two parts, the additional lift coefficient and the basic lift coefficient. The additional distribution is a function of the wing plan form and is independent of twist. The basic distribution is a function of the twist and is independent of the attitude of the airplane.

The induced drag coefficient is made up of three parts. The first is a function of the additional distribution, the second is the basic distribution, and the third is the interaction between the additional and basic distributions.

An alternative method for obtaining induced drag coefficient also is demonstrated. This latter method requires less time but it must be completely reworked for each value of the wing lift coefficient. *Bulletin of the Virginia Polytechnic Institute*, June, 1945, 31 pages, 14 illus.

Stresses in Ring Structures. L. G. Whitehead. It is noted that the simple ring frames that are a common feature of metal fuselage construction are being superseded in some large aircraft by more complicated frames in which one or more cross members are added to stiffen the frame.

It is stated that the stress distribution in simple rings is readily analyzed by the standard methods for redundant structures, but the direct extension of these methods to more complicated cases leads normally to the solution of a number of simultaneous equations. The writer proposes a method that avoids this difficulty by breaking down the calculation into a number of simple steps and then applying the principle of superposition to combine the results so obtained. In this respect the proposed method is equivalent to the Hardy Cross moment distribution method or to R. V. Southwell's method of the systematic relaxation of constraints, although in many applications the final superposition of loadings is so simple that the full moment distribution or relaxation procedure is not required. *The Journal of The Royal Aeronautical Society*, October, 1945, pages 646–651, 7 illus.

Correlation of Stress Concentration with Fatigue Strength of Engine Components. Charles W. Gadd, Andrew Zmuda, and N. A. Ochiltree. It is pointed out that the research work reported in publications for the purpose of guiding the designer in interpreting his mathematical or experimental stress analysis in terms of fatigue strength is primarily based on tests of simple beam specimens rather than on the actual machine component as manufactured. Tests of the latter type in which it has been possible to make a direct check on the validity of laboratory stress measurements are described. The writers state that the results have given them greater confidence in the practical utility of laboratory test methods than would be justified from conventional material strength data. *SAE Journal*, November, 1945, pages 640–647 (Transactions), 12 illus.

The Fatigue Strength of Aluminum and Magnesium Alloys. H. F. Moore. Suggestions are offered to aid designers and users of structural machine parts made of light metal alloys. Sections of the paper discuss the ratio of endurance limit to tensile strength, the effect of range of stress during a cycle, "the notch sensitivity" of aluminum and magnesium alloys, the effects of surface condition on the endurance limits of light alloys, and "size effect." *Aluminum and Magnesium*, November, 1945, pages 14–17, 28, 29, 4 illus.

The Euler Critical Load for Pinned-Pinned "Polynomial" Tapered Struts. F. J. Turton. Because the differential equation for the deflection of a tapered strut cannot usually be solved by formal methods, the writer attacks the problem in the reverse direction. Given the deflection-curve as a polynomial, he finds the shape of the longitudinal section struts of given strength. It is stated that although the shapes so found appear quite different from those for struts "of uniform stress," it is possible to get substantial saving in weight for a given strength (for some of the examples up to 11 per cent, the theoretic maximum being 13.4 per cent). *The Journal of The Royal Aeronautical Society*, October, 1945, pages 639–645, 5 illus.

Influence of Shear on the Deflection of Structures. Leon Beskin. It is shown that the common practice of neglecting the effect of shear deformation when calculating the deflections of structures may lead to important errors in stress distribution. The magnitude of the deformation attributable to shear in beams is examined and a critical review of conventional expressions is made. The results are successively applied to simply supported beams, to continuous beams, and to arches and frames. *Industrial Aviation*, November, 1945, pages 20, 22–24, 26, 58–60, 16 illus.

Superchargers

Various Types of Compressors for Supercharging. R. J. S. Pigott. Points of view are expressed regarding the characteristics of different types of compressors for supercharging aircraft engines. It is stated that while the centrifugal supercharger is excellently suited to aviation service and to relatively constant-speed, Diesel-engine service, it is not of value for cases of considerable variation in speed where full boost is required at all speeds. It is further stated that the Roots-type blower has had a justified development for low-pressure boost, but is not valuable for compression ratios much in excess of 1.6 because it has no adiabatic compression.

Objections to the vane-type supercharger, which has an adiabatic compression, are considered. In the writer's opinion, it is somewhat complex in structure, and has not yet shown satisfactory efficiency compared to other types. The Elliott-Lysholm screw-type and the new P.L. internal-gear type appear to him to give great promise for satisfactory supercharging at the higher pressures beyond the range of the Roots type, and appear to be the best present line of development. *SAE Journal*, November, 1945, pages 678–684, 22 illus.

Testing

A.I.D. Test House. The purpose, physical layout, facilities, equipment, and work of the Aeronautical Inspection Directorate Test House at Harefield, England, are described. Based on an inspection tour, an impression is given of some of the more interesting aspects of the procedures carried out at this laboratory which contains devices for the testing of all forms of aircraft materials and components. The equipment and functions noted are those of the establishment's five main divisions: (1) Material Division; (2) Aircraft Equipment Division; (3) Meteorology Division; (4) Administrative Section; and (5) Maintenance Section. *Flight*, November 1, 1945, pages 475, 476, 480, 3 illus.; "Inspection Laboratory," *The Aeroplane*, November 2, 1945, pages 510, 511, 5 illus.; "A.I.D. Test House, Harefield," *The Engineer*, November 2, 1945, pages 342–344, 6 illus.; November 9, 1945, pages 361, 362, 3 illus.

Testing Equipment

Testing Electrical Installations in Aircraft. Arthur Clark. A description is given of a test rig that enables the entire electrical installation of an aircraft to be tested and adjusted at an early stage in the assembly. The device was developed in the factory of A. W. Hawksley, Ltd., for use on Albemarle aircraft. The general principles of the test rig, circuit design, and

"The Modern Magic Carpet"*

LIKE the magic carpet of Arabian Nights, the Bell helicopters will offer a new concept of flying. For these helicopters can fly forward . . . backward . . . sideways . . . and ascend and descend vertically. They can land in or take off from otherwise inaccessible terrain. They can carry passengers and cargo from door to door. They can hover motionless in the air to perform specialized functions. Truly here is an aircraft that will become "The Modern Magic Carpet."

The Bell helicopters, at present, are not being developed to replace the family flivver. They are designed for many practical commercial, industrial and military applications—for public service of a kind which only the helicopter can perform. And Bell Aircraft engineering is conclusive evidence that they incorporate the advanced thinking in design and workmanship which has won this company its reputation of being the *"Pacemaker of Aviation Progress."*

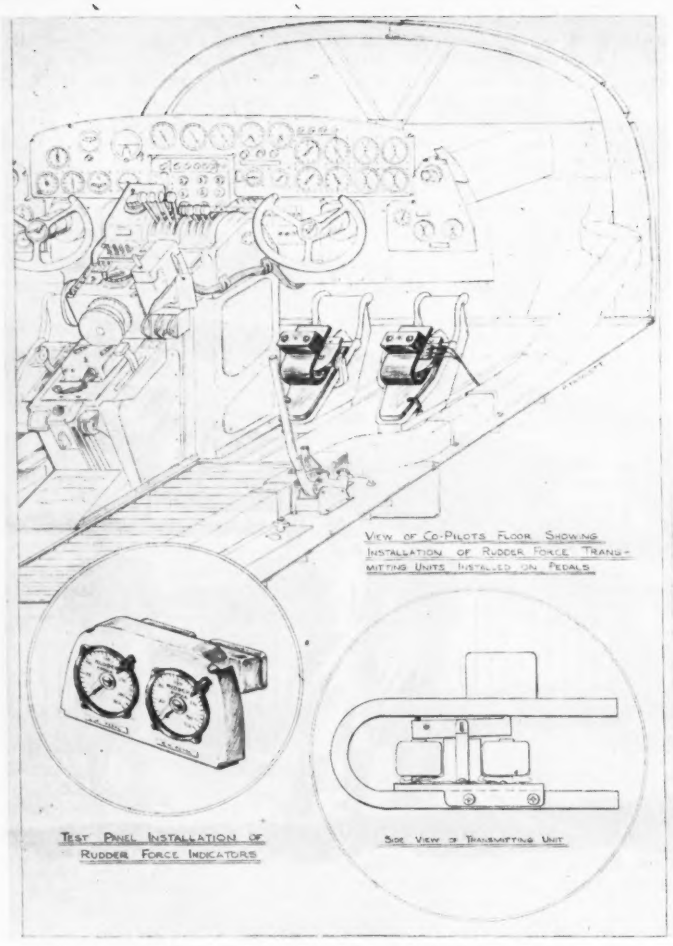
*Reg. applied for U.S. and principal foreign countries.

BELL *Aircraft* **CORPORATION**

Buffalo 5, New York

© Bell Aircraft Corporation

PACEMAKER OF AVIATION PROGRESS


VIEW OF CO-PILOTS FLOOR SHOWING INSTALLATION OF RUDDER FORCE TRANSMITTING UNITS INSTALLED ON PEDALS
TEST PANEL INSTALLATION OF RUDDER FORCE INDICATORS
SIDE VIEW OF TRANSMITTING UNIT

Rudder-control force indicators installed in cockpit of B-24 Liberator.

construction are explained. The possibilities of applying the principles to test rigs for other types of aircraft are considered. *Aircraft Engineering*, October, 1945, pages 306–308, 3 illus.

Measuring Forces on Rudder Controls. O. W. Ehlers. Information is given relative to the design, construction, and operation of a portable unit for measuring rudder control forces. This indicator is reported to consist essentially of a U-shaped steel strap, within which is mounted an inductance ratio gage. It has a micarta base and can be installed without even partly dismantling the rudder-control system. *Aero Digest*, November 1, 1945, pages 83, 133, 2 illus.

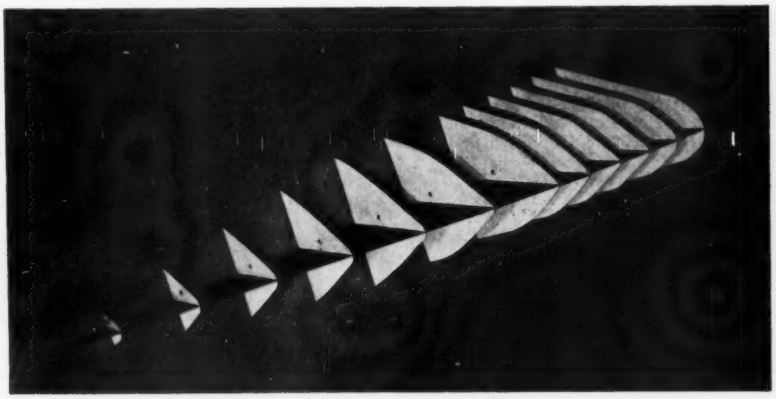
Transient Recording Pickup Methods. Edward J. Partington and Sydney E. Westman. Reference is made to the advances in recording technique which have been made by using the moving-mirror type of oscillograph as the basic recording instrument. Consideration is given to transient recording pickup methods. Various methods of indicating pressure transients in hydraulic and pneumatic systems are described. The practical utility of transient recording is illustrated by giving the case history of a power-brake valve for admitting a controlled amount of fluid to a brake mechanism from a hydraulic system maintained at high pressure. *Automotive and Aviation Industries*, November 1, 1945, pages 20–24, 64, 12 illus.

This Double-Duty Scoresby Saves Time and Space. Details are given about the special Scoresby unit for testing automatic pilots, devised by American Overseas Airlines, Inc. Built in two identical sections, this unit is composed of two automatic-pilot mounts on one base. The employment of one section for the instruction of instrument-maintenance mechanics does not affect the use of the other for operational testing of equipment, while both sides may be used for either purpose. Diagrams and photographs demonstrate the features of the Scoresby. *Aviation*, November, 1945, pages 159–161, 3 illus.

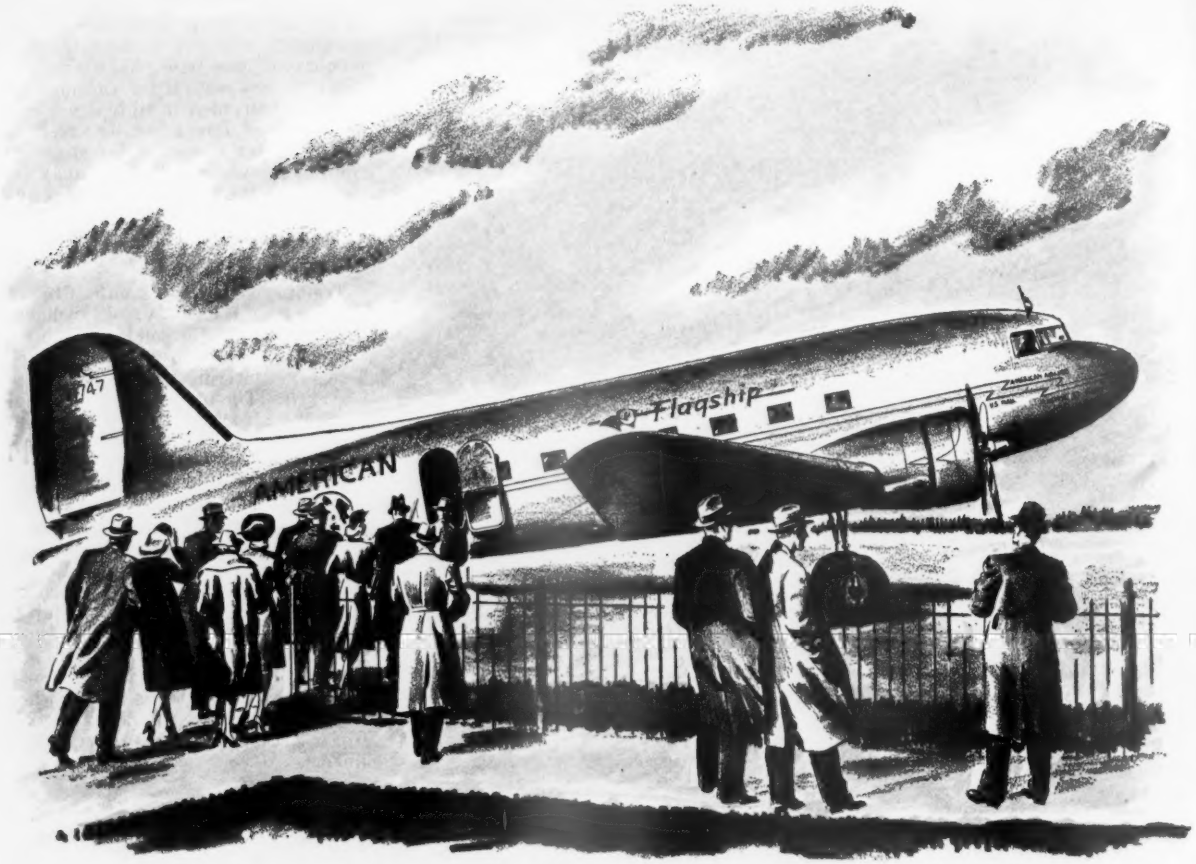
Trailing Airspeed Bomb Checks Pitot-Static Data. V. J. Schack. Features of a Consolidated Vultee Aircraft Corporation development for high-speed instrument calibration are surveyed. The innovation consists of a trailing air-speed bomb that measures static pressure at speeds in excess of 300 m.p.h., obviating the necessity for flying at low altitudes over a speed course on the ground in order to calibrate air-speed instruments. An "aerodynamically clean" body, the bomb has a static pressure head attached to one end and four stabilizing fins attached to the other end. Although it weighs only 25 lbs., it is stated to show no tendency toward whipping or oscillating at high speeds. Only a slight error has been noted when crosswinds were encountered. *Aero Digest*, November 1, 1945, page 96, 3 illus.

Tools and Equipment

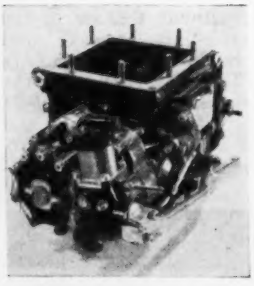
Layout Reproduction the Loftec Way. A process for reproducing lofting layouts is credited with having contributed greatly to the high production rate achieved by Republic Aviation Corporation in the manufacture of P-47 Thunderbolt fighters. It is described as being elementary in principle and operation, reproducing in a minimum of time the most intricate designs without the use of the camera, intermediary negative, and X-ray equipment, and requiring only ordinary skill and experience on the part of the operator. A metal sheet coated with luminous paint and masked with a white lacquered surface is employed. Using a sharp in-



The skeleton form of an aircraft-component structure assembled from Loftec templates, a layout reproduction method used by Republic Aviation Corporation.



19,400 Hours of Uninterrupted Service
. . . on the Route of the Flagships



American Airlines' records show that the Holley Carburetor serial #78 pictured in the inset at left, has given 19,400 hours of dependable, trouble-free service. It has flown some 3,104,000 miles and is still in service. In these hundreds of trips this carburetor metered approximately 875,000 gallons of high octane gasoline to the engine it served. Almost half a century of research and scientific manufacture has built stamina and dependability into every Holley Carburetor. That's why commercial airlines look to Holley for carburetor leadership and dependability of performance!

HOLLEY CARBURETOR COMPANY
5930 VANCOUVER AVE., DETROIT 4, MICHIGAN

HOLLEY

AIRCRAFT, AUTOMOTIVE, MARINE

CARBURETORS AND ACCESSORIES

strument, the draftsman scribes his design through the outer coating to expose the luminescence beneath, thus creating a master negative. Exposure of the luminous negative to strong light, either natural or artificial, activates the design so that it glows in a dark room, and prints are made from the negative in the usual manner. *Aviation*, November, 1945, page 135, 2 illus.

A Wood-Base Tooling Material. Harold A. Knight. The writer describes the properties and applications of Masonite die stock, a lignin semiplastic sheet product made of hard wood, "exploded" by high pressure and steam. Information is given about the application of this material to dies, forming blocks, jigs, fixtures, and chucks. Tables give the electrical and physical properties of this die stock. *Materials & Methods*, November, 1945, pages 1403–1406, 5 illus.

These Special Fixtures Speed Engine Mount Output. Harry Merle. A group of photographs depicts the special machining fixtures that enable engine mounts for the SB2C Helldiver to be located in a vertical position. It is shown how, by means of these units, all machining can be accomplished more simply and quickly in two fixtures, with precision alignment work. Step-by-step application of the fixtures in the fabrication process is illustrated. *Aviation*, November, 1945, pages 152, 153, 6 illus.

Training

Models Help Perfect Radar Bombing. An account is given of how special motion pictures of miniature models of the terrain helped brief B-29 crews for the radar bombing of Japanese targets. As one of the radar film projects of the Motion Picture Unit of the A.A.F., the described type of film gave instruction for the mission in three ways: (1) visual, or what the naked eye would see; (2) by changing the lens on the camera, the crews were given a magnification of the targets below so that these would appear on the screen exactly as they would be seen through a bombsight thousands of feet above; and (3) a film presenting a complete radar approach showed what the radar operators approaching the city would see on the radar scope when the target was completely obscured by clouds. *Aero Digest*, November 1, 1945, pages 40, 112, 2 illus.

Wanted: Effective Pilot Training. Arnold Warren. The writer stresses the need for a Canadian program whereby pilots will be taught to fly safely and efficiently. He outlines the principles upon which such a program should be based and suggests methods by which the goal could be achieved. To provide training for producing the desired standard of proficiency, the writer states that it is necessary to have (1) instructors capable of achieving it; and (2) license tests that make proficiency necessary. To provide candidates for training in required quantity, he stresses the need for having (1) license requirements simple enough to encourage flying; and (2) license tests that make training necessary. *Canadian Aviation*, November, 1945, pages 58, 60, 62, 98.

An Instructor's Views on Flying Clubs. Russ Brinkley. Attention is called to some poor flying practices commonly followed by students who are gaining their piloting experience as members of flying clubs. Standards of management and supervision for the clubs are strongly advocated to combat this type of "careless" flying. As an example of the discipline, safety, and efficiency which can be achieved, the management and operating policies of the Kansas University Jayhawk Flying Club are cited. *Aero Digest*, November 15, 1945, pages 68, 118, 1 illus.

Amateur vs. Professional Flight Instructions. E. C. Bailly. The inadequacies of receiving flight instruction from a private pilot rather than a rated instructor are demonstrated. However, it is conceded that, supplementary to a qualified instructor's training, an amateur teacher could aid the student pilot by enabling him to obtain additional hours of practice with the private pilot at the second set of controls. *Air Facts*, December, 1945, pages 64–71.

TWA Opens Flight Engineers' School. Noting the opening of a Flight Engineers' School by Transcontinental & Western Air, Inc., this article records some of the requirements for entrance to the school. It also outlines the duties of a flight engineer. *Aero Digest*, November 15, 1945, page 72, 1 illus.

Weight Control

Non-Level Weighing Procedure. Paul A. Piper. A simplified procedure for determining airplane weight and center of gravity is reported. It follows the general scheme of all tail-down methods except that it does not require special data or dimensions not ordinarily available to an aircraft operator. All necessary information may be obtained from the weight and balance handbook or from the airplane itself. Establishment of a routine procedure reduces computations and the possibility of errors to a minimum.

It is explained that with the new method a set of constant dimensions must be determined for each airplane model. The airplane is weighed level in the same manner as for a conventional level weighing. It is then weighed in a tail-down position and the constants are derived by simple arithmetical calculations. After the model constants have been determined, all subsequent weighings may be made in a tail-down or non-level position.

Weight constants are listed for a number of airplanes weighed by the new procedure. A second table illustrates the errors that may be expected to be inherent in the proposed system. *Weight Engineering*, Fall, 1945, pages 33–38, 4 illus.

Airplane Avoirdupois. David North. A description is given of the procedure for weighing commercial air transport planes, as carried out by American Airlines, Inc. Civil Aeronautics Administration regulations regarding the percentage of airplanes in a fleet which must be weighed are explained. The principles followed in the selection of airplanes which are representative of the average of a fleet are outlined. Preweighing and postweighing procedures are described. *Air Transport*, November, 1945, pages 51, 53, 55, 56, 59, 7 illus.

Welding

Multiple Arc Simplifies Welding of Aluminum Sheet. M. R. Rivenburgh and C. W. Steward. Details are reported about a new multiple-arc welding process that has simplified the arc-welding of difficult-to-weld, high-strength aluminum alloys. The properties of butt-welded joints produced by this process are described. Production advantages of the process as applied to the manufacture of aircraft parts are indicated. *Product Engineering*, November, 1945, pages 733–735, 3 illus.

The Application of Pressure Welding to the Manufacture of Aircraft Landing Gear. E. R. Proctor. The particulars of a program instituted by the Menasco Manufacturing Company to investigate the advantages of pressure welding as applied to the manufacture of aircraft landing gear. The writer traces the development of welding controls designed to make possible the consistent duplication of welds to meet the strength requirements of the aircraft industry, and also the development of an acceptable inspection method. The use of bend tests of full-size sections as a means of evaluating welds is described. Tables of test results are included. *The Welding Journal*, November, 1945, pages 1011–1017, 9 illus.

The Welding of Non-Ferrous Metals. Part VII. E. G. West. The fusion-welding of aluminum and its alloys is further considered in this continuation of the seventh installment of a series. Problems common to gas and arc methods and their solutions are treated in sections devoted to the flux reaction, flux compositions, gas reactions, filler metal, and the design of joints. *Sheet Metal Industries*, November, 1945, pages 1987–1992, 1994, 8 illus.

G&O
Radiators
31st Year

ENGINE COOLING
RADIATORS

•

OIL COOLERS

The G.O Manufacturing Co.

NEW HAVEN, CONNECTICUT

ENGINEERS
WANTED

Mechanical
Electrical
Civil

Preferably those with

Experience Adaptable to
AIRCRAFT

Layout Draftsmen
Aerodynamicists
Stress Analysts

Or others with at least several years of engineering experience which will serve as a basis for aircraft work.

Permanent positions are available in the engineering of such planes as the Martin 202 transport, commercial version of the Martin MARS, and other new commercial and military commitments. Write including full information on education, experience and background,

to Director of
Engineering Personnel,

The Glenn L. Martin Company

Baltimore 3, Maryland

Miscellaneous

Our Latest Show. A survey of the British and German aircraft, engines, and auxiliaries displayed at the Farnborough exhibition. These include the Rolls-Royce Nene, Armstrong-Siddeley A.S.X., and Metropolitan-Vickers F.2/4 jet units; de Havilland Goblin II, Vampire, and Dove; He 162; twin-jet Me 262; Hawker Fury I; Bristol Brigand I; Supermarine Spiteful XIV; Martin-Baker F18/39; Avro Lincoln II, Tudor I, and Lancastrian; Vickers Viking; and Halifax VIII. *Flight*, November 1, 1945, page 469; "Air Display," *The Aeroplane*, November 9, 1945, pages 538–541, 9 illus.

Revelations at Farnborough. Continuing a survey of the British and German aircraft, engines, and auxiliaries displayed at the Farnborough exhibit, this second of three articles discusses features of the equipment demonstrated there. Included in the data are particulars pertinent to the Halifax VIII; Avro Lancastrian, Lincoln II, and Tudor I; Vickers Windsor I and Viking; de Havilland Dove, Hornet I, Mosquito, and Vampire I; Hawker Sea Fury; Gloster Meteor IV; Fairey Spearfish I and Firefly IV; Bristol Brigand I; and Blackburn Firebrand IV. Among the power units noted are the Rolls-Royce Nene; Metropolitan-Vickers axial compressor unit; Armstrong Siddeley A.S.X.; de Havilland Goblin; Junkers Jumo 904; BMW 003; Bristol Hercules He 20sm; Centaurus CE22sm; and Napier Sabre Va. *Flight*, November 8, 1945, pages 503–507, 19 illus.; "Comparative Progress in Jet Propulsion," *The Aeroplane*, November 9, 1945, pages 528, 529, 9 illus.

Two Decades: A Statistical Study of Aviation. Statistics supplied in charts and tables show the pattern aviation has followed through war, peace, depression, and prosperity. Charts reveal the fluctuating rate of aircraft manufacture from the mid-twenties to the present postwar level. Statistics on employment, air-line operation, surplus aircraft, and airports are included. Charts designed to provide a basis for an appraisal of aviation's future also are supplied. One of these shows what effect increases in production volume will have on light-plane costs. The opinions of leading members of the industry on trends in aircraft design and power-plant developments are assembled in a special section. *Western Flying*, October, 1945, pages 41–48, 3 illus.

Atomic Engineering? Theodore von Kármán. Reference is made to the new avenues of engineering activities which have been opened by the discovery of means of releasing atomic energy. It is stated that the engineering profession has found itself unprepared to attack the new task. It is indicated that there has been too great a tendency to restrict engineering teaching to scientific knowledge that has immediate applications. The importance of giving the engineer an education that will enable him to follow the progress of science is emphasized. *Mechanical Engineering*, October, 1945, pages 672, 679.

Glass Laminates

(*Continued from page 14*)

less aircraft are unlimited, since these aircraft will be essentially flying radar housings.

What is the significance of this development to industry? The authors believe that the advent of this new basic material will eventually change present concepts of aircraft design and manufacture and influence every phase of the aircraft field including design, engineering, tooling, fabrication, and maintenance.

Bibliography

Evaluation of Material Properties for Application to Aircraft Structures, Army Air Forces Technical Report No. 4963, July 6, 1943.

Evaluation of Sandwich Combinations for Aircraft Structure, Army Air Forces, Air Technical Service Command, Engineering Division Memorandum Report Serial No. ENG-51-45119-1-2, February 15, 1944.

Rheinfrank, G. B., Jr., and Norman, W. A., *Application of Glass Laminates to Aircraft*, Modern Plastics, Vol. 21, No. 9, May, 1944.

Desired Properties and Test Procedures for Low Density Materials for Core of Sandwich Type Construction, Army Air Forces, Air Technical Service Command, Engineering Division Memorandum Report Serial No. ENG-56-M4595, Add. V., August 19, 1944.

Molded Glass Fiber Sandwich Fuselage for BT-15 Airplane, Army Air Forces Technical Report No. 5159, November 8, 1944.

Report on Construction of a Molded BT-15 Plaskon-Glass Cloth Aft Fuselage Monocoque Section for United States Army Air Forces Contract No. W33-038 ac-6301, January, 1945.

Evaluation of Synthetic Core Materials for Sandwich Type Aircraft Structures, Army Air Forces, Air Technical Service Command, Engineering Division Memorandum Report Serial No. TSEAL-2-45119-1-11, March 1, 1945.

Rheinfrank, G. B., Jr., and Norman, W. A., *Core Materials for Sandwich Structures*, Modern Plastics, Vol. 22, No. 11, July, 1945.

Meyer, L. S., and Case, J. C., *Honeycomb Core in Sandwich Structure*, Modern Plastics, Vol. 22, No. 11, July, 1945.

Source Material

For the information of readers, the following lists the periodicals, house organs, and other publications regularly received and reviewed.

The prices listed are for single issues and yearly subscriptions to recipients in the United States. Subscription prices to house organs are in many cases not available but may be obtained directly from the offices of the organization.

The frequency of publication is indicated by the following symbols: M, monthly; SM, semimonthly; BM, bimonthly; W, weekly; BW, biweekly; D, daily; Irreg., irregularly; Q, quarterly.

Periodicals

Aero Digest, 515 Madison Ave., New York 22, N.Y., SM, $0.50 $3.00.

The Aero Field, Francis J. Field, Ltd., Sutton Coldfield, England, 10 issues per year, 6d., 5s.

Aero Products, 271 Madison Ave., New York 16, N.Y., M.

Aeromodeller, Wilmary House, Merton Lane, Highgate, London, N. 6, M, 1s., 15s.

Aeronáutica, Avda. de Mayo 1370, Buenos Aires, M, $0.60 (pesos), $4.50 (pesos).

Aeronautics, Tower House, Southampton St., Strand, London, W.C.2, M, 2s., 26s. 6d.

L'Aérophile, 7 rue Saint-Lazare, Paris, 9e, M, 35 fr., 175 fr. per half yr.

The Aeroplane, Bowling Green Lane, London, E.C.1, W, 1s., 58s.

The Aeroplane Spotter, Bowling Green Lane, London, E.C.1, BW, 3d., 8s. 8d.

Les Ailes, 77, Boulevard Malesherbes, Paris, 8e, 5 fr. per issue.

Air Age Education News, Air Age Education Research, 100 E. 42d St., New York 17, N.Y., BM.

Air Facts, 30 Rockefeller Plaza, New York 20, N.Y., M, $0.25, $3.00.

Air Mail Magazine, A. Phillips, Newport, Monmouthshire, M, 4d., 5s.

Air News, 545 5th Ave., New York 17, N.Y., M, $0.20, $2.00.

L'Air pour les Jeunes et les Sports Aériennes, 71, avenue des Champs-Élysées, Paris, 8e, M, 12 fr., 130 fr.

Air Trails Pictorial, 122 E. 42d St., New York 17, N.Y., M, $0.25, $2.50.

Air Transport, 330 W. 42d St., New York 18, N.Y., M, $0.50, $5.00.

Air Transportation, 10 Bridge St., New York 4, N.Y., M, $0.50, $5.00.

Air World, 241 Church St., New York 13, N.Y., BM, $0.15, $0.90.

Aircraft, 62 Flinders St., Melbourne, C.1, M, 1s. per issue.

Aircraft Engineering, 12 Bloomsbury Sq., London, W.C.1, M, 2s. 3d., 26s.

Aircraft Production, Dorset House, Stamford St., London, S.E.1, M, 2s. 6d., £1 14s. 6d.

Airlanes, 340 W. 57th St., New York 19, N.Y., M, $0.25, $2.50.

Airmail Digest, Charles B. Charmats, Sylvania, Ohio, Irreg.

Airports, 1170 Broadway, New York 1, N.Y., M, $0.25, $3.00.

Airports and Ground Engineering (Supplement to Parks & Sports Grounds), 92, Victoria St., London, S.W. 1, M, 9d., 10s.

Aluminum and Magnesium, 425 W. 25th St., New York 1, N.Y., M, $3.00 yr.

American Aviation, American Bldg., Washington 4, D.C., SM, $0.25, $4.00.

American Aviation Daily, American Bldg., Washington 4, D.C., D, $170 yr.

American Aviation Directory, American Bldg., Washington 4, D.C., Semi-annually, $5.00, $7.50.

American Aviation Traffic Guide, 139 N. Clark St., Chicago 2, Ill., M, $0.50, $5.00.

American Helicopter, 32 E. 57th St., New York 22, N.Y., M, $0.35, $3.50.

The American Mercury, 570 Lexington Ave., New York 22, N.Y., M, $0.25, $3.00.

Atomic and Gas Turbine Progress, 2 W. 45th St., New York 19, N.Y., $5.00 yr.

Automotive and Aviation Industries, Chestnut & 56th Sts., Philadelphia 22, Pa., SM, $0.25, $1.00.

Avia, Victoria 788, Buenos Aires, M, $0.50 (*m/n*), $5.00 (*m/n*).

Aviação, Rua Uruguiana, 104, Rio de Janeiro, M, $4.00 (cruzeiros), $40 (cruzeiros).

Aviación, 429 H. W. Hellman Bldg., Los Angeles 13, Calif., BM, $1.00 yr.

Aviation, 330 W. 42d St., New York 18, N.Y., M, $0.50, $3.00.

Aviation and Yachting, 2816 Eaton Tower, Detroit 26, Mich., M, $0.25, $2.00.

Aviation Equipment, 1170 Broadway, New York 1, N.Y., M.

Aviation Maintenance, 205 E. 42d St., New York 17, N.Y., M, $0.50, $5.00.

Aviation News, 1357 National Press Bldg., Washington 4, D.C., W, $0.50, $5.00.

Aviation Review, 31 Willcocks St., Toronto 5, Ontario, M, $0.25, $3.00.

Aviation Service Magazine, 549 W. Washington Blvd., Chicago 6, Ill., BM.

British Plastics, Dorset House, Stamford St., London, S.E.1, M, 1s. 6d., 20s.

The Buy-Plane, 303-A East Pike, Seattle 22, Wash., SM, $0.10, $1.00.

Canadian Air Cadet, 122 Wellington St., Ottawa, Ontario, M, $0.10, $1.00.

Canadian Aviation, 481 University Ave., Toronto 2, Ontario, M, $0.25, $2.00.

Chile Aéreo, Club Aéreo de Chile, Av. Bulnes 80, Santiago de Chile, M, $5.00 (pesos), $50 (pesos).

Collier's, The Crowell-Collier Publishing Co., Springfield, Ohio, W, $0.10, $3.00.

Commercial Aviation, 341 Church St., Toronto, Ontario, M, $0.25, $3.00.

La Conquête de l'Air, 13 rue de Bréderode, Brussels, Belgium, M, 5 fr. per issue.

Contact, 113 W. 42d St., New York 18, N.Y., M, $0.20, $2.00.

Cross Country News, M. I. Hall, 1007-A 13th St., Lubbock, Tex., W, $5.00 yr.

Current Aviation, 400 S. Front St., Columbus 15, Ohio, W, $0.80 yr.

Diesel Power & Diesel Transportation, 192 Lexington Ave., New York 16, N.Y., M, $0.35, $3.00.

Distribution Age, 100 E. 42d St., New York 17, N.Y., M, $0.30, $3.00.

Ejército y Armada, Av. Roque Saenz Peña 501, Buenos Aires, M, $0.50 ctvos., $12 *m/n*.

EMCO Monthly Journal, Marks Stamp Co., Ltd., 258 College St., Toronto 2, Ontario, M, $0.50 yr.

The Engineer, 28 Essex St., Strand, London, W.C.2, W, 1s., £3 3s.

Engineering, 35 Bedford St., Strand, London, W.C.2, W, 1s. 2½d., £3 3s.

Engineering Materials and International Power Review, Africa House, Kingsway, London, W.C.2, BM, 3s., 15s.

Engineering News-Record, 330 W. 42d St., New York 18, N.Y., W, $5.00 yr.

The Engineers' Digest (American Edition), 1 Madison Ave., New York 10, N.Y., M, $0.75, $7.50.

Flight, Dorset House, Stamford St., London, S.E.1, W, 1s., £3 1s.

Flyg, Kungl. Tegnérgatan 35, Stockholm, Sweden, M, 45 öre, K. 59:7.

Flying, 185 N. Wabash Ave., Chicago 1, Ill., M, $0.35, $4.00.

Flying Age, 67 W. 44th St., New York 18, N.Y., M, $0.15, $1.80.

Gliding, 4658 Portage Rd., Kalamazoo 85, Mich., M, $0.25, $3.00.

Heating and Ventilating, 148 Lafayette St., New York 13, N.Y., M, $0.30, $2.00.

Indian Aviation, 13 Ezra Mansions, P.O. Box 2361, Calcutta, India, M, 8 annas, 7 rupees 8 annas.

Industrial Aviation, 185 N. Wabash Ave., Chicago 1, Ill., M, $2.00 yr.

Industrial Engineering, 416 Wall St., Los Angeles 13, Calif., M, $2.00 yr.

Industrial Standardization, American Standards Assn., 70 E. 45th St., New York 17, N.Y., M, $0.35, $4.00.

Instruments, 1117 Wolfendale St., Pittsburgh 12, Pa., M, $2.00 yr.

International Aviation (Foreign News Supplement to American Aviation Daily), American Building, Washington 4, D.C., W, $100 yr.

Iron Age, 100 E. 42d St., New York 17, N.Y., W, $0.35, $8.00.

Journal de la Marine Marchande et de la Navigation Aérienne, 190, Boulevard Haussmann, Paris, 8e, W, 40 fr. per issue.

Kunststoffe, Edwards Bros., Inc., 300 John St., Ann Arbor, Mich., M, $15 yr.

Light Metals, Bowling Green Lane, London, E.C.4, M, 1s. 6d., 20s.

Luftfahrtforschung, Edwards Bros., Inc., 300 John St., Ann Arbor, Mich., M, $12 yr.

Machine Design, Penton Bldg., Cleveland 13, Ohio, M, $0.50, $6.00.

Machinery, 148 Lafayette St., New York 13, N.Y., M, $0.40, $4.00.

Materials & Methods, 330 W. 42d St., New York 18, N.Y., M, $0.25, $2.00.

Mechanix Illustrated, 1501 W. Broadway, New York 18, N.Y., M, $0.15, $1.80.

The Military Surgeon, Army Medical Museum, Washington 25, D.C., M, $0.50, $4.00.

Model Airplane News, 551 5th Ave., New York 17, N.Y., M, $0.20, $2.00.

Le Modèle Réduit d'Avion, 74 rue Bonaparte, Paris, 6e, M, 18 fr., 80 fr. per half year.

Modern Metals, Burnham Bldg., Chicago 1, Ill., M, $3.00 yr.

Modern Plastics, 122 E. 42d St., New York 17, N.Y., M, $0.50, $5.00.

Modern Transport, 105–109, Strand, London, W.C.2, W, 3d., 20s.

Mundo Aeronáutico, Rivadavia 945, Buenos Aires, M, $0.30 (pesos), $4.00 (pesos).

The N.A.T.A. Dispatch, National Aviation Trades Assn., 214 E. Armour Blvd., Kansas City 2, Mo., 36 issues per yr.

Official Aircraft Price Guide, Aircraft Advisory Service, Inc., P.O. Box 81, Columbus 16, Ohio, Q, $6.50 yr.

The Official Foreign Air Mail Guide, 11 W. 42d St., New York 18, N.Y., M, $1.50 yr.

The Official Guide of the Airways, 608 S. Dearborn St., Chicago 5, Ill., M, $0.50, $5.00.

Pacific Plastics, 124 W. 4th St., Los Angeles 13, Calif., M, $0.30, $3.00.

The Plane-Trader, 249 Washington St., Brooklyn 1, N.Y., W, $0.60 yr.

Plastics, 540 N. Michigan Ave., Chicago 11, Ill., M, $5.00 yr.

Plastics, Bowling Green Lane, London, E.C.1, M, 1s. 6d., 19s.

Plastics and Resins, 299 Madison Ave., New York 17, N.Y., M, $0.35, $3.00.

Plastics Reporter, 1214 Hyde Park Ave., Hyde Park 36, Mass., M, $0.20, $2.00.

Plastics World, 551 5th Ave., New York 17, N.Y., M, $0.25, $3.00.

Popular Mechanics Magazine, 200 E. Ontario St., Chicago 11, Ill., M, $0.25, $2.50.

Popular Science Monthly, 353 4th Ave., New York 10, N.Y., M, $0.25, $2.50.

Product Engineering, 330 W. 42d St., New York 18, N.Y., M, $0.50, $5.00.

Production Equipment, 328 S. Jefferson St., Chicago 6, Ill., M.

Protar, Buchdruckerei Vogt-Schild AG., Solothurn, M, 1.00 Sw. Fr., 15 Sw. Fr.

Recent Periodical Articles, Library, Parks Air College, Inc., E. St. Louis, Ill., M, $5.00 yr.

Revista Aérea Cubana, O'Reilly 170, Habana, Cuba, M, $0.10, $1.00.

Revista Aérea Latinoamericana, 515 Madison Ave., New York 22, N.Y., M, $0.15, $1.00.

Revista do Ar, Aero Clube de Portugal, Av. da Liberdade, 226, Lisboa, M, 120$00.

România Aeriană, Calea Floreasca Nr. 13, Bucharest, M.

Rutas del Aire, Melincué 2501, Buenos Aires, M, $0.30 (*m/n*), $3.50 (*m/n*).

The Saturday Evening Post, Independence Sq., Philadelphia 5, Pa., W, $0.10, $6.00.

Schweizer Aero-Revue, Hirschengraben 22, Zürich, M, 80 Rappen, 10 Sw. Fr.

Science Illustrated, 345 Hudson St., New York 14, N.Y., M, $0.25, $3.00.

Scientific American, 24 W. 40th St., New York 18, N.Y., M, $0.35, $4.00.

Sheet Metal Industries, 49, Wellington St., London, W.C.2, M, 1*s.* 3*d.*, 15*s.*

Skyways, 444 Madison Ave., New York 22, N.Y., M, $0.25, $3.00.

Southern Flight, 1901 McKinney Ave., Dallas 1, Tex., M, $0.25, $2.00.

Steel Processing, 108 Smithfield St., Pittsburgh 30, Pa., M, $0.25, $2.50.

Svensk Flygtidning, Sallerupsvägen 262, Malmoe, Sweden, M, 45 öre, K. 5:-.

Tekhnika Vozdushnogo Flota, Izdatel'stvo BNT NKAP, Moscow, M, 8 R per issue.

Trade-a-Plane Service, Crossville, Tenn., 3 issues per month, $0.25 yr.

U. S. Air Services, Transportation Bldg., Washington 6, D.C., M, $0.25, $3.00.

V.D.I. Zeitschrift, Edwards Bros., Inc., 300 John St., Ann Arbor, Mich., W, $19 yr.

Velocidade, rua Conselheiro Chrispiniano, 90, São Paulo, Brazil, M, Cr. $2.50, Cr. $30.

Vingar, Tjärhovsgatan 22, Stockholm, Sweden. M, 50 öre per issue (Philip Andrews Publishing Co., 545 5th Ave., New York 17, N.Y.).

Vliegwereld, Gedempte Oudegracht 138, Haarlem, Netherlands, SM, 30 ct., F 7.50.

Western Aero-Trades, 2800 Regina Way, Sacramento 14, Calif., M, $0.10, $1.00.

Western Airman, Ellis Bldg., Phoenix, Ariz., SM, $0.05, $0.50.

Western Flying, 304 S. Broadway, Los Angeles 13, Calif., M, $0.25, $2.00.

Whites Aviation, 605 Dilworth Bldg., Auckland, C.1, N.Z., M, 1*s.* (U.S. distributors, American Aviation Associates, American Bldg., Washington 4, D.C., $3.00 yr.)

Wings, McGraw-Hill Publishing Co., Inc., 330 W. 42d St., New York 18, N.Y., M.

Wings, 1 Marion St., Wellington, N.Z., M, 6*d.*, 10*s.*

Wings, London House, 21 Loveday St., Johannesburg, Union of South Africa, M, 6*d.*, 7*s.* 6*d.*

Society and University Publications

Accelerator, Metropolitan Section, Society of Automotive Engineers, Inc., 29 W. 39th St., New York 18, N.Y., 10 issues per yr.

Aero Mechanic, Aircraft Builders Lodge 751, A. F. of L., 5513 Airport Way, Seattle 8, Wash., W, $1.50.

Aeronautical Briefs, Aeronautical Chamber of Commerce of America, Inc., 610 Shoreham Bldg., Washington 5, D.C., M.

Aeronautical Chamber of Commerce of America, Inc., Weekly Washington Bulletin, 610 Shoreham Bldg., Washington 5, D.C., W.

Aeronautical Engineering Review, Institute of the Aeronautical Sciences, Inc., 2 East 64th St., New York 21, N.Y., M, $0.30, $3.00.

Les Ailes Brisées, Société d'Entr'aide aux Aviateurs Mutilés, Veuves et Orphelins, 9, avenue Daniel-Lesueur, Paris, 8e, Q.

The Air Force Woman, The National Assn. of Air Forces Women, 1702 K St., N.W., Washington 6, D.C., M.

The Air Line Mechanic, The Air Line Mechanics Assn., International, 155 N. Clark St., Chicago 1, Ill., M.

The Air Line Pilot, The Air Line Pilots Assn., International, 3145 W. 63d St., Chicago 29, Ill., M.

Air Power League, Bulletin, 350 5th Ave., New York 1, N. Y., M.

Air Training Corps Gazette, Published for the Air League of the British Empire by The Rolls House Publishing Co., Ltd., 2 Breams Bldgs., London, E. C. 4, M, 6*d.*, 7*s.*

Air Transport Safety, National Safety Council, 20 North Wacker Drive, Chicago 6, Ill., M.

Airport Digest, National Aeronautic Assn., 1025 Conn. Ave., N.W., Washington 6, D.C., M.

Airpost Journal, American Air Mail Society, Albion, Pa., M, $0.20, $2.00.

American Aeronaut, Aeronautical Industrial District Lodge 727, International Assn. of Machinists, 5501 Lankersheim, North Hollywood, Calif., W, $0.03, $1.50.

American Helicopter Society, Semi-Technical Bulletin, Newfield P.O. Box 4029, Bridgeport 7, Conn., Irreg., $0.50 per issue.

American Meteorological Society, Bulletin, Milton, Mass., M, $0.35, $3.50.

American Rocket Society, Journal (formerly Astronautics), 130 West 42d St., New York 18, N.Y., Q, $1.50, $4.00.

American Society for Testing Materials, Bulletin, 260 S. Broad St., Philadelphia 2, Pa., BM, $0.25, $1.50.

American Society of Mechanical Engineers, Transactions, 29 W. 39th St., New York 18, N.Y., M, $1.50, $12.

Army Ordnance, Army Ordnance Assn., 705 Mills Bldg., Washington 6, D.C., BM, $0.75, $4.50.

Astro-Jet, Glendale Rocket Society, 3262 Castera Ave., Glendale 8, Calif., 3 issues per yr., $1.00 yr.

The Australasian Engineer (including Science Sheet), 20 Loftus St., Sydney, N.S.W., Australia, M, 1*s.*, 12*s.*

Automotive War Production, Automotive Council for War Production, New Center Bldg., Detroit 2, Mich., M.

Aviation Progress, County Chamber of Commerce, Los Angeles, Calif., M.

Aviation Writers Assn., Newsletter, P.O. Box 856, Grand Central Annex, New York 17, N.Y., Irreg.

Boletín de Aviación, National Aeronautic Assn., 1025 Conn. Ave., N.W., Washington 6, D.C., M.

Bureau Veritas, Registre Aéronautique, 31, rue Henri-Rochefort, Paris, 17e, annually with monthly supplements.

Les Cahiers d'Aérodynamique, Chaire d'Aviation de la Sorbonne, Groupes d'Études Aéronautiques de la Faculté des Sciences, Université de Paris, 1 rue Victor-Cousin, Paris, 5e, Irreg.

Chinese Institute of Engineers, Journal, 630 5th Ave., New York 20, N.Y., semiannually, $0.50, $1.00.

Chirp, The Early Birds, Lt. Col. Ernest Jones, Secretary, 3401 16th St., N.W., Washington, D.C., Irreg.

Civil Air Patrol League, News, 545 5th Ave., New York 17, N.Y., M.

Combined British Astronautical Societies, Official Bulletin, 26, Chesterford Gardens, Hampstead, London, N.W.3, M.

Conference of International Air Traffic Operators, Bulletin, 31-32, Haymarket, London, S.W.1, M, 1*s.*, 10*s.* 6*d.*

Corrosion, National Assn. of Corrosion Engineers, 318 Southern Standard Bldg., Houston 2, Tex., Q, $0.75, $3.00.

Electrical Engineering, American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N.Y., M, $1.50, $12.

Faraday Society, Transactions, 98 Great Russell Street, London, W.C.1, M, 5*s.* per issue.

Fasteners, American Institute of Bolt, Nut and Rivet Manufacturers, 1550 Hanna Bldg., Cleveland 15, Ohio, Q.

For Your Information, National Aeronautic Assn., 1025 Conn. Ave., N.W., Washington 6, D.C., W.

The Foundation, Engineering Society of Detroit, 100 Farnsworth Ave., Detroit, Mich., M.

The Franklin Institute, Journal, Benjamin Franklin Parkway at 20th St., Philadelphia, Pa., M, $0.60, $6.00.

Haul Down and Ease Off, National Assn. of American Balloon Corps Veterans, P.O. Box 2040, Wichita, Kan., BM.

Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill., M, $0.25, $2.00.

Ilmailu, Suomen Ilmailuliitto, Mannerheimintie 16 A, Helsinki, Finland, M, 10 MK, 75 MK.

Industrial Quality Control, Published by the Society of Quality Control Engineers in cooperation with the University of Buffalo, Crosby Hall, University of Buffalo, Buffalo 14, N.Y., BM, $1.25, $6.00.

Institute of Radio Engineers, Proceedings, 330 W. 42d St., New York 18, N.Y., M, $1.00, $10.

Institute of Transport, Journal, 15 Savoy St., Victoria Embankment, London, W.C.2, Q, 2*s.* 6*d.* per issue.

The Institute of Welding, Transactions, 2, Buckingham Palace Gardens, London, S.W.1, Q, 10*s.* 6*d.* per issue.

The Institution of Mechanical Engineers, Journal and Proceedings, Storey's Gate, St. James's Park, London, S. W. 1, 35*s.* yr.

International Commission for Air Navigation, Bulletin of Information, 60 bis, avenue d'Iéna, Paris, 16e, Q.

International Commission for Air Navigation, Official Bulletin, 60 bis, avenue d'Iéna, Paris, 16e, Irreg.

Journal of Aeronautical Meteorology, Meteorological Committee, Air Transport Association of America, 10 Richards Road, Kansas City 6, Mo., Q, $0.50, $2.00.

Journal of Applied Mechanics, 29 W. 39th St., New York 18, N.Y., Q, $1.35, $5.00.

Journal of Applied Physics, 57 E. 55th St., New York 22, M, $0.70, $7.00.

Journal of Aviation Medicine, Aero Medical Assn. of the United States, 2642 University Avenue, St. Paul 4, Minn., BM, $1.25, $5.00.

The Journal of Engineering Education, Prince and Lemon Sts., Lancaster, Pa., 10 issues per year, $0.50, $3.00.

The Journal of Meteorology, American Meteorological Society, Milton 86, Mass., Q, $6.00 yr.

Journal of Scientific Instruments, 19, Albemarle St., London, W.1, M, 3*s.* 4*d.*, 40*s.*

Journal of the Aeronautical Sciences, Institute of the Aeronautical Sciences, Inc., 2 East 64th St., New York 21, N.Y., M, $0.70, $7.00.

The Log, The British Air Line Pilots' Assn., 9–10 Marble Arch, London, W.1, M.

Lubrication Engineering, American Society of Lubrication Engineers, 135 S. LaSalle St., Chicago 3, Ill., Q, $0.75, $3.00.

MagNEWSium, The Magnesium Assn., 30 Rockefeller Plaza, New York 20, N.Y., Q.

Mechanical Engineering, American Society of Mechanical Engineers, Inc., 29 W. 39th St., New York 18, N.Y., M, $0.75, $6.00.

Metropolitan Airmail Cover Club, Bulletin, The Malin Studios, 225 W. 46th St., New York 19, N.Y., M.

Model Aviation, Air Youth Div., National Aeronautic Assn., 1025 Connecticut Ave., Washington 6, D.C., M, $1.00.

National Aeronautics, National Aeronautic Assn., 1025 Conn. Ave., Washington 6, D.C., M, $6.00 yr.

New York University, Contributions from the College of Engineering, University Heights, New York 53, N.Y., Irreg.

Ohio State University, Engineering Experiment Station, Bulletin, Columbus, Ohio, BM.

Ohio State University, Engineering Experiment Station, News, Columbus, Ohio, M.

Pacific Aeronautical Library, Check-List, 6715 Hollywood Blvd., Los Angeles 28, Calif., Irreg.

Photogrammetric Engineering, The American Society of Photogrammetry, P.O. Box 18, Benjamin Franklin Sta., Washington, D.C., $1.50 per issue.

Planes, Aeronautical Chamber of Commerce of America, Inc., 610 Shoreham Bldg., Washington 5, D.C., M.

Polish Engineering Review, Association of Polish Engineers in Canada, 3432 Drummond St., Montreal, Quebec, BM, $0.50, $3.00.

Press Summary, Society of British Aircraft Constructors, Ltd., 32, Saville Row, London, W.1, W.

Production Information, Automotive Council for War Production, New Center Bldg., Detroit 2, Mich., M.

The Propeller, Air Service Veterans' Assn., 7141 Jeffery Ave., Chicago 49, Ill., Q.

Quarterly of Applied Mathematics, Brown University, Providence 12, R.I., Q, $2.00, $6.00.

The Review of Scientific Instruments, American Institute of Physics, 57 E. 55th St., New York 22, N.Y., M, $0.50, $5.00.

Royal Aeronautical Society, Journal, 4, Hamilton Place, London, W.1, M, 7*s.* 6*d.*, £4 10*s.*

Royal Meteorological Society, Quarterly Journal, 49, Cromwell Rd., London, S.W.7, Q, 7*s.* 6*d.* per issue.

SAE Journal, Society of Automotive Engineers, Inc., 29 W. 39th St., New York 18, N.Y., M, $1.00, $10.

Soaring, Soaring Society of America, Inc., Elmira, N.Y., BM, $4.00 yr.

Sociedad Cubana de Ciencias Físicas y Matemáticas, Revista, Habana, Cuba, Irreg., $0.50, $3.00 per vol. of 6 issues.

Society of Motion Picture Engineers, Journal, Hotel Pennsylvania, New York 1, N.Y., M, $1.00, $10.

Spacewards, Combined British Astronautical Societies, 17, Southcote Ave., Tolworth, Surbiton, Surrey, Q.

Standards Review, British Standards Instn., 28 Victoria St., Westminster, London, S.W.1, Q. 2s., 7s.

Technique et Science Aéronautiques, Association des Anciens Élèves de l'École Nationale Supérieure de l'Aéronautique, 6 rue Cimarosa, Paris, 16e, BM, 160 fr. yr.

The Thermal, The Southern California Soaring Assn., Inc., 453 S. Spring St., Los Angeles 13, Calif., M, $2.00 yr.

United States Naval Institute, Proceedings, Annapolis, Md., M, $0.50, $4.00.

Virginia Polytechnic Institute, Engineering Experiment Station, Bulletin, Blacksburg, Va., 16 issues per yr.

War Medicine, American Medical Assn., 535 N. Dearborn St., Chicago 10, Ill., M, $0.75, $6.00.

Warplane Production, Aircraft War Production Council, Inc., 7046 Hollywood Blvd., Los Angeles 28, Calif., BM.

Weekly Washington Bulletin, Aircraft Industries Assn. of America, Inc., Shoreham Bldg., Washington 5, D.C., W.

Weight Engineering, Society of Aeronautical Weight Engineers, Inc., 143 N. Brand Blvd., Glendale 3, Calif., Q, $0.50, $1.75.

The Welding Journal, 33 W. 39th St., New York 18, N.Y., M, $0.75, $5.00.

West Coast Air Mail Society, Bulletin, Ralph A. Freiburg, 4142 26th St., San Francisco 14, Calif., BM.

Wings, Minnesota Council, National Aeronautic Assn., 236 Radisson Hotel, Minneapolis 2, Minn., M, $0.25, $3.00.

Wings Club, Inc., Bulletin, 50 Vanderbilt Ave., New York 17, N.Y., M.

Government Publications

Aerodrome Abstracts, compiled by the Department of Scientific and Industrial Research and issued in collaboration with the Air Ministry, The Institution of Civil Engineers, St. George St., Westminster, London, S.W.1, M.

Aeronáutica, Clasificador F-468, Santiago de Chile, M, $6.00 (pesos), $50 (pesos).

Air Force, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.20, $2.00.

Air-Tact, Michigan Wing 63, Civil Air Patrol, 2310 Book Tower, Detroit, Mich., M.

Anahuac, Calle 21 Núm. 500 Col. Moctezuma, Mexico, D.F., $0.25 Mex., $3.00 Mex.

Army Life, Recruiting Publicity Bureau, U.S. Army, Governors Island, N.Y., M.

Australia, Council for Aeronautics, Reports, Box 4331, G.P.O., Melbourne, Irreg.

Belgium, Administration de l'Aéronautique, Avis aux Navigateurs Aériens, Boulevard du Régent, 53, Brussels, M.

Belgium, Service Technique de l'Aéronautique, Bulletin, 72, Chaussée de Waterloo, Rhode-Saint-Genèse, Belgium, Irreg.

Bulletin of War Medicine, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., M, $0.40, $4.65.

CAP News Bulletin, Civil Air Patrol, Texas & Pacific Bldg., Fort Worth 2, Tex., W.

Civil Aeronautics Journal, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.05, $0.50.

Contact, School of Aviation Medicine, U.S. Naval Air Station, Pensacola, Fla., Q.

The Department of State Bulletin, U.S. Govt. Printing Office, Washington 25, D.C., W, $0.10, $2.75.

Domestic Commerce, U.S. Govt. Printing Office, Washington 25, D. C., M, $0.10, $1.00.

Foreign Air News Digest, Air Transport Information Division, Economic Bureau, Civil Aeronautics Board, Washington 25, D.C., BW.

Foreign Commerce Weekly, U.S. Govt. Printing Office, Washington 25, D.C., W, $0.10, $4.50.

France, Direction des Industries Aéronautiques, Notes Techniques, Ed. Blondel la Rougery, 7, rue Saint-Lazare, Paris, Irreg.

France, Direction des Industries Aéronautiques, Publications Scientifiques et Techniques, Ed. Blondel la Rougery, 7, rue Saint-Lazare, Paris, Irreg.

France, Ministère de l'Air, Service de Documentation et d'Information Technique, Bulletin Mensuel de Documentation, Paris, M.

France, Ministère de l'Éducation Nationale, Centre National de la Recherche Scientifique, Bulletin Analytique, 18, rue Pierre-Curie, Paris, 5e, M.

France, Secrétariat d'État à l'Aviation, Bulletin des Services Techniques, Ed. Blondel la Rougery, 7, rue Saint-Lazare, Paris, Irreg.

Gt. Brit., Aeronautical Research Committee, Reports and Memoranda, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., Irreg.

Gt. Brit., Air Ministry, Library, Additions List, The Librarian, Whitehall, London, S.W.1, M.

Gt. Brit., Air Registration Board, Notice to Licensed Aircraft Engineers and to Owners of Civil Aircraft, Brettenham House, Strand, London, W.C.2, Irreg.

Gt. Brit., Ministry of Aircraft Production, Abstracts from the Scientific and Technical Press, The Secretary (R.T.P. 3), Ministry of Aircraft Production, Millbank, London, S.W.1, M.

Gt. Brit., Ministry of Aircraft Production, Translations, The Secretary (R.T.P. 3), Millbank, London, S.W.1, M.

Gt. Brit., Stationery Office, Government Publications, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., M.

Index Aeronauticus, The Secretary (R.T.P. 3), Ministry of Aircraft Production, Millbank, London, S.W.1, M, 1s. per issue.

Ireland, Department of Industry and Commerce, Transport and Marine Branch, Civil Aviation Notices, Kildare St., Dublin, Irreg.

Journal of Research of the National Bureau of Standards, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.30, $3.50.

List of Selected United States Government Publications, U.S. Govt. Printing Office, Washington 25, D.C., SM.

Log of Navigation, Army Air Forces, Ellington Field, Texas, M, $0.25, $3.00.

Meddelanden fran Luftfartsmyndigheten, Kungl. Luftfartstyrelsen, Stockholm 8, Sweden, Irreg

México, Departamento de Aeronáutica Civil, Publicación, Mexico, D.F., M.

Monthly Weather Review, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.20, $2.00.

Myśl Lotnicza, Headquarters, Polish Air Force, Chantrey House, Eccleston St., London, S.W.1, M, 1s. 6d., 15s.

Netherlands, Nationaal Luchtvaartlaboratorium, Verslagen en Verhandelingen, Sloterweg 145, Amsterdam, annually.

New Zealand, Air Department, Civil Aviation Branch, Information Circular, The Controller of Civil Aviation (C.A.8), Air Department, Wellington, C.1, N.Z., M.

Papel Péga-Mosca, Escola Técnica de Aviação, Ministério da Aeronáutica, Rua Visconde de Parnaíba, São Paulo, Brasil, W.

Perú, Primera Región Aérea, Boletín, Base Aérea "Teniente Coronel Ruiz," Chiclayo, M, 11.00 S/o. yr.

Production and Engineering Bulletin, British Supply Council in North America, P.O. Box 680, Benjamin Franklin Sta., Washington 4, D.C., M.

Revista de la Fuerza Aéres, Ministerio de Defensa Nacional, Santiago de Chile, M.

Royal Australian Air Force Air News, Australian News and Information Bureau, 610 5th Ave., New York 20, N.Y., M.

Skrzydła, Headquarters, Polish Air Force, Chantrey House, Eccleston St., London, S.W.1, BW, 6d., 15s.

Technical News Bulletin of the National Bureau of Standards, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.05, $0.50.

U.S., Army Air Forces, Air Technical Service Command, Translations, Wright Field, Dayton, Ohio, Irreg.

U.S., Army Air Forces, Technical Publications for Army Air Forces Technical Libraries, Book List, Library Branch, Washington 25, D.C., Irreg.

U.S., Army War College, Library, Abstracts of Selected Periodical Articles of Military Interest, Washington 25, D.C., M.

U.S., Civil Aeronautics Administration, Airworthiness Directives, Mandatory Notes, Service Notes, Technical Development Notes, Technical Development Reports, Washington 25, D.C., Irreg.

U.S., Civil Aeronautics Board, Report of Formal Economic Proceedings, Civil Aeronautics Board, Washington 25, D.C., M, $1.00 yr.

U. S., Forest Products Laboratory, Progress Reports, Madison, Wis., Irreg.

U.S., N.A.C.A., Reports, Superintendent of Documents, Washington 25, D.C., Irreg.

U.S., N.A.C.A., Technical Memorandums, National Advisory Committee for Aeronautics, Washington 25, D.C., Irreg.

U.S. N.A.C.A., Technical Notes, National Advisory Committee for Aeronautics, Washington 25, D.C., Irreg.

U.S., Office of the Air Surgeon, Convalescent Services Division, Information Letter, Washington 25, D.C., M.

U.S., Weather Bureau, Mt. Washington Observatory, Icing Reports, Gorham, N.H., Irreg.

United States Government Publications, Monthly Catalog, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.20, $2.00.

De Vliegende Hollander, Voorlichtingsdienst, Directoraat der Luchtstrijdkrachten, Vliegveld Ypenburg, The Hague, Netherlands, M.

Company Publications

Aero, Aero Division, Minneapolis-Honeywell Regulator Co., 2753 4th Ave. S., Minneapolis 8, Minn., M.

Aero News Letter, Aero Insurance Underwriters, 111 John St., New York 7, N.Y., BM.

Aero Research Technical Notes, Aero Research, Ltd., Duxford, Cambridge, England, M.

Aerolite, Ryan Aeronautical Co., Lindbergh Field, San Diego, Calif., W.

The Air Box, Chandler-Evans Corp., So. Meriden, Conn., BM.

The AiResearcher, AiResearch Mfg. Co., Sepulveda Blvd., Los Angeles, Calif., M.

Airflow, Academy of Aeronautics, Jackson Heights, L.I., N.Y., and Casey Jones School of Aeronautics, Newark, N.J., M.

Airport Manager's Service Bulletin, Aero Insurance Underwriters, 111 John St., New York 7, N.Y., BM.

Allisonews, Allison Division, General Motors Corp., Indianapolis, Ind., SM.

Aluminum News Letter, Aluminum Co. of America, Pittsburgh 19, Pa., M.

The ASCo Aircrafter, American Stove Co., 1825 E. 40th St., Cleveland 3, Ohio, BW.

Aviation Bulletin, The British Aviation Insurance Co. Ltd., 500 Place d'Armes, Montreal, Quebec, M.

Bakelite Review, Union Carbide and Carbon Corp., 30 E. 42d St., New York 17, N. Y., Q.

The Ballardair, The Walter M. Ballard Corp., 331 Madison Ave., New York 17, N.Y., M.

The Beech Log, Beech Aircraft Corp., Wichita, Kan., W.

The Bee-Hive, United Aircraft Corp., East Hartford, Conn., BM.

Bell Aircraft News, Bell Aircraft Corp., Buffalo, N.Y., W.

Bell Laboratories Record, 463 West St., New York 14, N.Y., M, $2.00 yr.

The Bell Ordnance News, Bell Aircraft Corp., Burlington, Vt., W.

The Bellringer, Bell Aircraft Corp., 2050 Elmwood Ave., Buffalo, N.Y., M.

Bendix Communiqué, Philadelphia Div., Bendix Aviation Corp., 4700 Wissahickon Ave., Philadelphia 44, Pa., M.

Bendix Radio Engineer, Bendix Radio Div., Bendix Aviation Corp., Baltimore 4, Md., Q, $2.00 yr.

Between Ourselves, Trans-Canada Air Lines, 360 McGill St., Montreal, Quebec, M.

Bladesman, Propeller Div., Curtiss-Wright Corp., Caldwell, N.J., Irreg.

The B-Liner, Braniff Airways, Inc., Dallas 9, Tex., M.

Boeing Contact, Boeing Airplane Co., Wichita, Kan., M.

Boeing Magazine, Boeing Aircraft Co., Seattle, Wash., M.

Boeing Plane Talk, Boeing Airplane Co., Wichita, Kan., W.

Breeze American, Breeze Corporations, Inc., 41 S. 6th St., Newark, N.J., M.

British Airways News Letter, British Overseas Airways Corp., Airways House, London, S.W.1. M.

Bulaero, Cal-Aero Technical Institute, Glendale, Calif., M.

Bulletin of Technical Data for the Plywood Industry, The Resinous Products & Chemical Co., 222 W. Washington Sq., Philadelphia 5, Pa., Irreg.

California Douglas Airview News, Douglas Aircraft Co., Inc., Santa Monica, Calif., W.

Caminos del Aire, Pan American Airways, Inc., Bolivar 18, Mexico, D.F., M.

Canadian Car Journal, English Edition, Canadian Car & Foundry Co. Ltd., 621 Craig St., West, Montreal, Quebec, M.

Cessquire, Cessna Aircraft Co., Wichita, Kan., M.

The Chance Vought News, Chance Vought Aircraft Div., United Aircraft Corp., Stratford, Conn., SM.

Chicago Douglas Airview News, Douglas Aircraft Co., Inc., Park Ridge, Ill., W.

Cielos de Bolivia, Lloyd Aéreo Boliviano, Avenida Camacho No. 54, Casilla No. 691, La Paz, Bolivia, M.

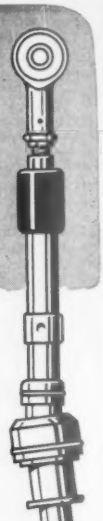
Circle-News, The B. F. Goodrich Co., 500 S. Main St., Akron 11, Ohio, W.

Classroom Clipper, Pan American Airways, Inc. 135 E. 42d St., New York 17, N.Y., M.

SIMMONDS PRECISION-BUILT

PUSH★PULL

CONTROLS



Solve problems in . . .

PRECISION DETOURS VIBRATION

Are you taking advantage of the most advanced design methods in handling your remote control problems?

Simmonds Push-Pull Controls, developed to meet exacting aircraft standards, are being increasingly specified by industrial engineers in many fields. More than half a million Simmonds controls are today giving rugged, trouble-free service in installations that require the ultimate in accuracy—eliminating awkward pulley-and-cable and rod-and-bellcrank set-ups. Especially successful in solving problems involving vibration and difficult contours. A wide variety of accessories and fittings make Simmonds controls adaptable to many purposes.

Let Simmonds engineers help solve your remote control problems. There is no obligation.

Send Your Control Problems to Simmonds Control Headquarters

Simmonds

AEROCESSORIES, INC.

30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y.

Simmonds PRODUCTS INC.

Branch Offices: Dayton, Ohio • Glendale, California • Montreal, Canada

Let Simmonds Analyze Your Control Problem

Simply submit the basic requirements, as follows:

- **What does the control operate?**
- **LOAD: Compression (lbs.) Tension (lbs.)**
- **VIBRATION CHARACTERISTICS**
- **TEMPERATURE CONDITIONS**
- **PRESENT SYSTEM**
- **FLEXIBLE OR RIGID HOUSING?**

Make sketches of top and side views of installation. Use regular graph paper and indicate unit of measure.

OTHER SIMMONDS PRODUCTS:

Pacitor (Electronic) Fuel Gauges — Spark Plugs
Hydraulic Accumulators — Automatic Engine Controls
Aneroid Capsules — Chronometric Radiosondes
Fasteners and Clips of Specialized Design

NOW

A New WITTEK Hose Clamp

For Personal Planes

TYPE FBP

TYPE FBSS

TYPE WWD

The great fund of aviation production knowledge developed during the war by aircraft parts manufacturers is now being turned to peacetime planes, commercial and personal. Wittek now offers manufacturers of these planes the FBP Hose Clamp.

The new Wittek FBP Hose Clamp, made from stainless steel and having a band ½" wide, follows the basic FB design, incorporating lighter construction and economy—yet retaining the high Wittek standards for dependability, high grade materials and good workmanship.

In addition to the FBP, FBSS and WWD, Wittek manufactures a complete line of Hose Clamps of various designs. There is a Wittek Hose Clamp to meet every aircraft application. Write for full particulars.

WITTEK

MANUFACTURING CO.

4305-15 W. 24th Place, Chicago 23, Ill.

Aviation HOSE CLAMPS WMCo.

Nearly 4000 TYPES of CASTERS & WHEELS

Darnell Double Ball-Bearing Casters and E-Z-Roll wheels reduce floor wear to a minimum, lengthen the life of equipment and increase the efficiency of employees—Write for 192 page Darnell Caster and Wheel Manual.

DARNELL CORP. LTD. 60 WALKER ST. NEW YORK 13, N.Y.
LONG BEACH 4, CALIFORNIA 36 N. CLINTON, CHICAGO 6, ILL.

The Clipper, Pacific-Alaska Div., Pan American World Airways System, San Francisco 19, Calif., SM.

The Comet, Ampco Metal, Inc., Milwaukee 4, Wis., M.

The Connecting Link, Link Aviation Devices, Inc., Binghamton, N.Y., BM.

Construction Glues, I. F. Laucks, Inc., 911 Western Ave., Seattle, Wash., BM.

The Continental Eagle, Continental Air Lines, Inc., Municipal Airport, Denver, Colo., M.

Convair News, Consolidated Vultee Aircraft Corp., Miami, Fla., W.

Curtiss Fly-Leaf, Airplane Div., Curtiss-Wright Corp., Municipal Airport, Buffalo, N.Y., BM.

Curtiss Wright-er, Curtiss-Wright Corp., Lambert Field, St. Louis, Mo., W.

De Havilland Mosquito, de Havilland Aircraft of Canada, Ltd., Postal Sta. L, Toronto, Ontario, M.

Douglas Airview, Douglas Aircraft Co., Inc., Santa Monica, Calif., M.

Douglasair Foreign Letter, Douglas Aircraft Co., Inc., Santa Monica, Calif., M.

Dow Diamond, The Dow Chemical Co., Midland, Mich., BM.

The Dragon, The Fafnir Bearing Co., New Britain, Conn., M.

The Du Pont Magazine, E. I. du Pont de Nemours & Co. (Inc.), Wilmington, Del., BM.

The Eagle, Consolidated Vultee Aircraft Corp., Ft. Worth, Tex., W.

Eastern Aircraftsman, Eastern Aircraft Div., General Motors Corp., Linden, N.J., M.

Edo Log, Edo Aircraft Corp., College Point, L.I., N.Y., M.

Edo Weekly Log, Edo Aircraft Corp., College Point, L.I., N.Y., W.

The Educational Focus, Bausch & Lomb Optical Co., Rochester, N.Y., Q.

Electrical Communication, International Standard Electric Corp., 67 Broad St., New York, N.Y., Q, $0.75, $3.00.

Ethyl News, Ethyl Corp., 405 Lexington Ave., New York 17, N.Y., M.

FAD, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp., Hagerstown, Md., BW.

Fairchild News, Fairchild Camera and Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N.Y., M.

The Faircrafters, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp., Burlington, N.C., W.

Flagship World, American Airlines, Inc., 100 E. 42d St., New York 17, N.Y., BM.

Fleetwings Arrow, Fleetwings Div., Kaiser Cargo Inc., Bristol, Pa., M.

The Flying M, Menasco Mfg. Co., Burbank, Calif., BW.

Franklin Facts, Aircooled Motors Corp., Liverpool Rd., Syracuse 8, N.Y., Irreg.

General Aircraft News, London Air Park, Feltham, Middlesex, England, M.

Glider Release, Laister-Kauffmann Aircraft Corp., 5660 Oakland Ave., St. Louis, Mo., M.

The Globe Beam, Globe Aircraft Corp., Fort Worth 6, Tex., M.

GM Folks, General Motors Corp., Detroit, Mich., M.

The Grace Log, W. R. Grace & Co., 7 Hanover Sq., New York 5, N.Y., Q.

Grumman Plane News, Grumman Aircraft Engineering Corp., Bethpage, N.Y., W.

Guiberson Guidon, Guiberson Corp., Dallas, Tex., BW.

The Hamilton Standard Blade, Hamilton Standard Propellers Div., United Aircraft Corp., 362 S. Main St., East Hartford, Conn., SM.

Hangar Flying, Lockheed Aircraft Corp., Burbank, Calif., M.

The Hecker Michronicle, A. W. Hecker, 1976 E. 66th St., Cleveland, Ohio, M.

The Higgins Aircrafter, Higgins Aircraft, Inc., P.O. Box 32, New Orleans 6, La., W.

Hobart Arc Welding News, The Hobart Bros. Co., Troy, Ohio, Irreg.

Hughesnews, Hughes Aircraft Co., Florence at Teale Sts., Culver City, Calif., SM.

Inco, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., Q.

Instrumentation, The Brown Instrument Co. Div., Minneapolis-Honeywell Regulator Co., Wayne and Roberts Aves., Philadelphia 44, Pa., BM.

The Intava World, International Aviation Associates, Artillery House, Artillery Row, London, S.W.1, M.

Interstate-ments, Interstate Aircraft and Engineering Corp., 641 S. Oxford Ave., Los Angeles, 5, Calif., SM.

The Jahco News, Jack & Heintz, Inc., Solon Rd., Bedford, Ohio, M.

Kellett News, Kellett Aircraft Corp., 58th & Grays Ave., Philadelphia 43, Pa., SM.

Kidde Industry, Walter Kidde & Co., Inc., 140 Cedar St., New York 6, N.Y., BM.

The Kinner Log, Kinner Motors, Inc., 635 W. Colorado Blvd., Glendale 4, Calif., M.

The Kollsman Instrument Dial, Kollsman Instrument Div., The Square D Co., 80-08 45th Ave., Elmhurst, L.I., N.Y., M.

Kollsman Pointers, Engineering Dept., Kollsman Instrument Div., The Square D Co., 80-08 45th Ave., Elmhurst, L.I., N.Y., BM.

The Lamp, Standard Oil Co. of New Jersey, 30 Rockefeller Plaza, New York 20, N.Y., BM.

The Lear Log, Lear Incorporated, Piqua, Ohio, M.

Lockheed Cross and Crown, Lockheed Christian Fellowship, Inc., Roscoe 3, Calif., M.

Lockheed Log, Lockheed Aircraft Corp., Burbank, Calif., Q.

The Lockheed Star, Lockheed Aircraft Corp., Burbank, Calif., W.

Lubrication, The Texas Co., 135 E. 42d St., New York 17, N.Y., M.

Lukens Steel Co., Technical Library, Bulletin, 1940 Gillen St., Coatesville, Pa., M.

The Lycoming Star, Lycoming Div., The Aviation Corp., Williamsport, Pa., M.

McDonnell Airscoop, McDonnell Aircraft Corp., Lambert Field, St. Louis, Mo., W.

MAC Service Letter, Mutual Aircraft Conference, 919 N. Michigan Ave., Chicago 11, Ill., M.

The Martin Star, The Glenn L. Martin Co., Baltimore 3, Md., M.

Mechanical Topics, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., M.

Metco News, Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, N.Y., BM.

Miles Magazine, Miles Aircraft Ltd., The Aerodrome, Reading, Berks., Q, 1s. per issue.

New Horizons, Pan American Airways, Inc., 135 E. 42d St., New York 17, N.Y., M.

News Digest, Hill and Knowlton, 350 5th Ave., New York 1, N.Y., W.

News Digest, Pacific-Alaska Div., Pan American World Airways System, San Francisco 19, Calif., SM.

Nickel Cast Iron News, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., M.

Nickel Steel Topics, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., M.

Noorduyn Tale-Spin, Noorduyn Aviation Ltd., 1411 Crescent St., Montreal, Quebec, M.

North American Skyline, North American Aviation, Inc., Inglewood, Calif., BM.

North American Skywriter, North American Aviation, Inc., Inglewood, Calif., W.

North Ameri-Kansan, North American Aviation, Inc., of Kansas, Kansas City, Kan., W.

Northeast Airlines Gremlin, Northeast Airlines, Inc., 1 State St., Boston, Mass., Q.

The Northeast Airlines Up-to-the-Minute Man, Northeast Airlines, Inc., Commonwealth Airport, Boston, Mass., D.

The Northrop News, Northrop Aircraft, Inc., Northrop Field, Hawthorne, Calif., BW.

Oklahoma City Douglas Airview News, Douglas Aircraft Co., Inc., Oklahoma City, Okla., W.

Oscillator, Western Electric Co., 195 Broadway, New York, N.Y., Irreg.

PCA News, Pennsylvania-Central Airlines, Washington National Airport, Washington 25, D.C., M.

Pan Atlantic News, Atlantic Div., Pan American World Airways, La Guardia Field, New York, N.Y., W.

Panair em Revista, Panair do Brasil, S.A., Aeroporto Santos-Dumont, Rio de Janeiro, M.

Parks Air News, Parks Air College, E. St. Louis, Ill., M.

The Pegasus, Fairchild Engine & Airplane Corp., 30 Rockefeller Plaza, New York 20, N.Y., M.

Pesco Pilot, Pesco Products Co. Div., Borg-Warner, 11610 Euclid Ave., Cleveland 6, Ohio, M.

The Pick-Up, All American Aviation, Inc., 209 W. 9th St., Wilmington, Del., M.

Plane Fax, Aviation Division, Standard Oil Co. of Calif., Standard Oil Bldg., San Francisco 20, Calif., SM.

Plane Talk, Consolidated Vultee Aircraft Corp., Room 3301, 350 5th Ave., New York 1, N.Y., M.

Plastics Bulletin, Plastics Department, E. I. du Pont de Nemours & Co. (Inc.), Arlington, N.J., Irreg.

Plastics Newsfront, American Cyanimid Co., 30 Rockefeller Plaza, New York 20, N.Y., Q.

Profilometer Comments, Physicists Research Co., 343 S. Main St., Ann Arbor, Mich., Irreg.

Ranger's Cloud Buster, Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corp., Farmingdale, L.I., N.Y., SM.

The Red Seal, Continental Motors Corp., 415 Assn. of Commerce Bldg., Grand Rapids, Mich., M.

The Resinous Reporter, The Resinous Products & Chemical Co., 222 W. Washington Sq., Philadelphia 5, Pa., M.

The Rohm & Haas Reporter, Rohm & Haas Co., 222 W. Washington Sq., Philadelphia 5, Pa., M.

Rotol Digest, Reference Library, Rotol, Ltd., Gloucester, England, W.

Ryan Flying Reporter, Ryan Aeronautical Co., San Diego, Calif., M.

Ryan Sky News, The Ryan School of Aeronautics, Lindbergh Field, San Diego, Calif., M.

Service Engineering, Kent-Moore Organization, 485 W. Milwaukee Ave., Detroit, Mich., Irreg.

Shell News, Shell Progress, Shell Oil Co., Inc., 50 W. 50th St., New York 20, N.Y., M.

Simmonds Aeronews, Simmonds Aerocessories, Inc., 21-10 49th Ave., Long Island City, N.Y., BW.

Skyfarer, General Aircraft Corp., 43-02 Ditmars Blvd., Long Island City 5, N.Y., BW.

The Skyliner, Transcontinental & Western Air, Inc., Kansas City, Mo., M.

Sky Steps, Chicago and Southern Air Lines, Municipal Airport, Memphis 2, Tenn., M.

The Southernaire, Southern Airways, Inc., 400 Trust Co. of Georgia Bldg., Atlanta 3, Ga., M.

Spartan News, Spartan School of Aeronautics and Spartan Aircraft Co., Municipal Airport, Tulsa, Okla., M.

Speed, Western Air Lines, Inc., 510 W. 6th St., Los Angeles, Calif., M.

The Sperry News, Sperry Gyroscope Co., Manhattan Bridge Plaza, Brooklyn 1, N.Y., SM.

Sperryscope, The Sperry Corp., Manhattan Bridge Plaza, Brooklyn 1, N.Y., Q.

The Stabilizer, The Lincoln Electric Co., Coit Rd. & Kirby Ave., Cleveland 1, Ohio, BM.

The Stabilizer, Schweizer Aircraft Corp., County Airport, Elmira, N.Y., W.

Steel Horizons, Allegheny Ludlum Steel Corp., Brackenridge, Pa., Irreg.

The Stinsonair, Stinson Div., Consolidated Vultee Aircraft Corp., Wayne, Mich., BW.

Take-Off, North American Aviation, Inc., Dallas, Tex., W.

The Taylorcraft News, Taylorcraft Aviation Corp., Alliance, Ohio, M.

Technical Education News, McGraw-Hill Publishing Co., Inc., 330 W. 42d St., New York 18, N.Y., M.

Technograph, The Glenn L. Martin Co., Baltimore 3, Md.

The Texaco Star, The Texas Co., 135 E. 42d St., New York 17, N.Y., Q.

The Timmcrafter, Timm Aircraft Corp., 7801 Hayvenhurst Ave., Van Nuys, Calif., M.

Trade Winds, Wright Aeronautical Corp., Paterson, N.J., BM.

Transatlantic Air News, American Export Airlines, 25 Broadway, New York 4, N.Y., M.

Tulsa Douglas Airview News, Douglas Aircraft Co., Inc., Tulsa, Okla., W.

United Air Lines News, United Air Lines, Inc., 5959 S. Cicero Ave., Chicago 38, Ill., M.

U. S. Steel News, United States Steel Corp. of Delaware, 436 7th Ave., Pittsburgh, Pa., Q.

US, United States Rubber Co., 1230 6th Ave., New York 20, N.Y., M.

The Valve, Wilcox-Rich Div., Eaton Mfg. Co., Battle Creek, Mich., M.

The Volunteer, Consolidated Vultee Aircraft Corp., Nashville Div., Nashville, Tenn., W.

The Waco Word, Waco Aircraft Co., Troy, Ohio, M.

War Production Drive, Summerill Tubing Co., Bridgeport, Montgomery County, Pa., M.

The Wasp Nest, Pratt & Whitney Aircraft Corp. of Missouri, Kansas City, Mo., M.

Westinghouse Newsfront, Westinghouse Electric Corp., 306 4th Ave., Pittsburgh 30, Pa., M.

Wheelco Comments, Wheelco Instruments Co., Harrison & Peoria Sts., Chicago 7, Ill., BM.

Wing Tips, Mid-Continent Airlines, Inc., Waltower Bldg., Kansas City, Mo., M.

The Wingfoot Clan, Akron Edition, Goodyear Aircraft Corp., 1210 Massilon Rd., Akron 15, Ohio, W.

The Wingfoot Clan, Arizona Edition, Goodyear Aircraft Corp., Litchfield Park, Ariz., W.

Wright at the Moment, Wright Aeronautical Corp., Paterson, N.J., W.

Superior Engineering . . . basis of Collins quality leadership

Above all, the Collins Radio Company is an engineering outfit. 4.4% of the organization's entire personnel are graduate engineers.

They came to Collins because the Collins progressiveness and quality standards are their own ideals, and brought with them successful experience in both radio and allied electronic fields. They are the nucleus of the organization, from management on through.

These men determine and uphold the character of Collins radio communication equipment from inception, through all stages of research, design, production, quality control, field test and field service.

Aviation can look with confidence to Collins for the best available performance in air borne and ground station radio communication equipment. We will welcome an opportunity to consult you regarding your requirements.

COLLINS RADIO COMPANY
Cedar Rapids, Iowa
11 W. 42nd Street, New York 18, N. Y.

IN RADIO COMMUNICATIONS, IT'S . . . .

COLLINS

Government Publications

Army Air Forces

Radar Countermeasures. In explaining the principles and techniques of radar countermeasures, the Air Technical Service Command has revealed that the equipment includes search and intercept receivers for seeking out the enemy radar, and analyzers for defining the pulse frequency rate and determining what type of jamming transmission can be used against it. Two types of jamming systems are employed, spot jamming for disrupting particular received frequencies, and barrage jamming for jamming an entire frequency band In addition, these same countermeasure devices can be used to deceive or confuse the enemy by radiating sufficient jamming signals to mislead the enemy as to the area of attack. Deception countermeasures were employed in the North Sea area to direct German defenses away from the beachheads of Normandy, thus minimizing the enemy air opposition.

One of the most interesting of all the countermeasure devices used was the shredded aluminum foil known as "window," "chaff," and "rope." This foil was dropped from bombers to reflect enemy radar pulses and screen from enemy operators information as to the height, range, speed, and magnitude of the attacking force. Operational analysts working with the Eighth Air Force have calculated that the effectiveness of German radar-controlled antiaircraft fire against strategic missions during the period from September, 1944, to May 7, 1945, was only 25 per cent of normal because of the countermeasures activities of the A.A.F. On this basis, it is indicated that the countermeasures devices saved the U.S. forces in Europe approximately 450 bombers and 4,500 casualties. With the cash value of 450 four-engined aircraft computed at approximately $150,000,000, the total wartime radar countermeasures equipment (RCM) expenditures of the A.T.S.C. had been returned in monetary value of aircraft saved during 8 months of operation in one combat air force.

During the war, the Maintenance Division prepared installation, operation, maintenance, and modification instructions on more than 50 different types of radar countermeasures equipment, totalling approximately 60,000 sets used by the A.A.F. in the various theaters. More than 6,000 installation kits, together with field instructions, were assembled and shipped to the Eighth Air Force alone for installation in every heavy bomber assigned to that force.

In addition, personnel of the Engineering Division and Maintenance Division supervised the conversion of a number of heavy bombers into virtual flying countermeasures laboratories at various A.T.S.C. depots. These aircraft, known as "Ferrets," carried large quantities of RCM equipment, and were used to locate, analyze, and furnish intelligence information about enemy radar stations. Each aircraft required more than 9,000 man-hours to reconvert for this purpose and, in one instance, five "Ferrets" were completed in 33 days at one A.T.S.C. depot to meet an operational requirement deadline. *Air Technical Service Command.*

Strato-Planes Can Use Radio Eight Miles Up. Details of a high-altitude communications system to keep pilots and crew members of strato-flying airplanes in radio contact with ground stations and other aircraft have been revealed. This radio communications equipment, standard but highly secret for almost 2 years in the operations of Superfortresses against Japan, features automatic tuning with push-button control through eleven different channels. It operates at altitudes from 25,000 to 40,000 ft.

With an automatic system known as "Autotune," any one of the selected frequency channels can be "tuned in" in approximately 20 sec. after it is selected by pushing one of the corresponding buttons on the control box. A considerable saving of weight and space was realized since the new system weighs 110 lbs. as compared with the 215 lbs. of the old set. Installation problems also were cut down because the new set has only a few major parts that are set easily into a small space. Maintenance work is facilitated because the units of the new device are made to "plug-in" and can be removed and serviced separately. The set provides for transmission of the spoken word or Morse code signals. *Air Technical Service Command.*

"Corner Reflector" Radar Reflector Locates Liferafts. Rubber lifeboats are now equipped with a radar device designed to lead searching aircraft to them. Known as the "corner reflector" and weighing slightly more than 1 lb., this device was originally developed for the Navy by the National Defense Research Committee. It was then tested for A.A.F. use in the Electronic Subdivision at Wright Field and was procured in large quantities for operational use during the war. Two different models of the equipment have been developed—one for use with single-place rafts carried in fighter aircraft and the other in multiplace rafts carried by bombers.

The corner reflector is collapsible and is packed in small cartons placed in the life-raft packs that combat aviators carry on their backs along with their parachutes. The reflector is attached to a mast extending from the life raft. Its veins, made of dural or stainless steel, are 36 in. long and between them Monel metal wire is woven into a cloth mesh. It is this mesh that reflects the radar waves transmitted from the searching aircraft. The reflected waves appear as spots on the aircraft's radar scope, revealing the exact position of the life raft.

The corner reflector in the multiplace boats does not replace the famous "Gibson Girl" life-raft radio set that broadcasts S.O.S. in the international distress frequency. Single rafts have no radio equipment and the corner reflector is their only radio signal device.

It is reported that in the Pacific the radar reflector was used extensively because it could be easily detected on the wide stretches of water. It also offered security from enemy listening stations since it did not transmit a signal. It has no moving parts and is sturdily constructed and easily maintained. *Air Technical Service Command.*

Instructors Manual for Physical Retraining. This manual is intended for the use of enlisted men who are acting as physical instructors in a hospital for convalescents or in the convalescent ward of a regional or station hospital. Methods are outlined for the treatment of physical disabilities and for retraining men who have lost the ability to operate their own "body machinery." The methods involve exercises, massage and other special treatment in addition to mental stimulus and encouragement.

The book outlines the anatomy and physiology of the parts of the human body most commonly injured in

military operations. The common causes of disability are briefly explained, along with the techniques of physical and exercise therapy found most suitable for each type. *Air Forces Manual No. 24*, September, 1944.

Introducing Joe "Flight" Gremlin. The illnesses and other physical disturbances that accompany flight operations in military aircraft are explained in nontechnical language and illustrated by sketches of the cartoon type, for the benefit of Army Air Forces personnel. The booklet shows the parts of the body which are subject to stress during military flying operations and suggests exercises to strengthen the body against the effects of such stresses. *Air Forces Manual No. 26*, prepared by the Office of the Air Surgeon in collaboration with the Assistant Chief of Air Staff, Training, and published by the Training Aids Division, September, 1944.

Coming Home. The reactions experienced by Army airmen upon their return to their homes and civilian life are reviewed. Advice is given to such men for readjusting themselves to civilian activities. *AAF Manual 35-155-1*, June, 1945.

Let's Walk. The object of this book is to help convalescent airmen to learn to walk again after serious injuries. It contains suggestions for exercises calculated to accomplish the desired results. It deals with the use of crutches and artificial limbs and shows how these aids can be most satisfactorily employed in physical rehabilitation. *Air Forces Manual No. 49*, December, 1944.

Mediterranean Million. In a booklet of 33 pages an effort is made to give some of the most significant highlights of the record of the Mediterranean Allied Air Forces from November 8, 1942, to May 2, 1945. During this period these forces flew a total of 1,178,243 combat sorties against the Axis. The booklet contains a brief review of the growth and development of the organization, its long and arduous campaign, and its ultimate victory. The story indicates the results of a test of Allied cooperation in which the airmen of several free nations worked together in a common cause. Its Commanding Officer states that, as a proving ground for joint command, the Mediterranean Allied Air Forces pointed the way to peace and progress for the future.

Testimonials by the Customer. Statements made by captured German officers and men concerning the effectiveness of Allied air power are assembled in a booklet of 13 pages. The information given in these statements confirms the reports obtained during the conflict by the intelligence and reconnaissance divisions of the Allied armed forces with regard to the demoralizing and physically destructive effects of the bombing of Germany by the Allied air units.

Redeployment. An illustrated booklet of 18 pages contains a record of the work accomplished in transferring personnel and equipment of the Mediterranean Theater of Operations of the Army Air Forces after the conclusion of hostilities in southern Europe. The magnitude of the task is indicated by tabulated figures and charts. The statistics indicate the plans for the disposal of aircraft and the routes planned for redeploying aircraft from Europe to the United States and to other fields of operation. The concluding pages deal with the plans made for the employment of personnel required to remain in Europe, and for the recreational and educational activities to be provided for such personnel.

Log of Your Visit to MAAF. In a booklet of 36 pages an endeavor is made to incorporate pertinent facts regarding some of the more important air force targets, prepared on the occasion of a visit of a group of professional and governmental officials to the Headquarters of the Mediterranean Theater of Operations. The booklet does not give a complete record of the combat record of the units because of their great number and also because some targets were effaced by repairs made from time to time. However, there are included the major enemy factories, aircraft plants, marshalling yards, and transportation routes which were so heavily bombed in

USAIG UNITED STATES AIRCRAFT INSURANCE GROUP

America's
Strongest Source of
Aviation Insurance

★

THE U. S. GROUP

★

Comprising 62 Leading
American Owned
Stock Companies

UNITED STATES AVIATION UNDERWRITERS
INCORPORATED
80 JOHN STREET
NEW YORK, N. Y
ATLANTA
CHICAGO
LOS ANGELES

When you write to manufacturers
whose advertising appears
in the
Aeronautical Engineering Review,
it will be
of interest to the companies
and of benefit to the Institute if you
mention that you saw it
in the
Aeronautical Engineering Review

Italy, Austria, and western Czechoslovakia. *Prepared by Public Relations Office, Headquarters, Mediterranean Allied Air Forces.*

AAF Mechs Prepare for Peace. Photographs illustrate the brief text telling about the A.A.F. course of instruction which is preparing military personnel for C.A.A. certification as civilian aircraft and aircraft-engine mechanics. Holders of MOS Nos. 747, 750, and 2750 are eligible for the course, which is conducted in two sections—one for Aircraft-Engine Mechanics, the other for Aircraft Mechanics. Subjects included in the first section are carburetion, magnetos, ignition systems, power plants, lubrication, and propellers. The second section stresses rigging and assembly, wood fabric covering and doping, hydraulic systems, sheet metal and welding, plus Civil Air Regulations. *Air Force*, November, 1945.

Tempelhof Turnover. A description of the Tempelhof airdrome in Germany, now HQ. Berlin Air Command home base for various A.A.F. units. Particulars are given about the landing areas, buildings, and facilities of what is termed the world's greatest air terminal. *Air Force*, November, 1945.

Civil Aeronautics Administration

Aircraft Electrical Circuit Protective Devices. The Administration's policy to date concerning electrical-circuit protective devices has permitted the use of trip-free circuit breakers only, except that nontrip-free breakers were permitted in emergency circuits, such as those to propeller-feathering motors and emergency fuel-pump motors, provided flameproof cable was used in the circuits. The omission of any protective device in these emergency circuits was also permitted, provided flameproof cable was used. Fuses were not permitted in such circuits on new aircraft models.

As a result of considerable discussion of the foregoing policy, *Safety Regulation Release No. 187* was issued, with a questionnaire attached, to obtain the opinions of the parties most interested in the problem. On the basis of the answers received to the questionnaire, a new policy has been formulated by the Civil Aeronautics Administration in conjunction with the Aircraft Industries Association of America. The purpose of this release is to inform interested parties of that policy, which is as follows:

(1) Nontrip-free circuit breakers and flame-resistant cable (Specification AN-J-C48a or better) should be used in emergency circuits. Emergency circuits are defined as those the failure of which may result in the inability of the airplane to maintain controlled flight. Fuses should not be used in emergency circuits.

(2) Trip-free breakers or fuses should be used in nonemergency circuits, except that, if trip-free breakers are not available, nontrip-free breakers may be used in these circuits provided flame-resistant cable (Specification AN-J-C48a or better) is used. However, the nontrip-free breakers should be replaced with trip-free breakers when the latter become generally available. An aircraft manufacturer who installs nontrip-free breakers in nonemergency circuits should issue a service bulletin at such time as trip-free breakers become generally available, indicating what nontrip-free breakers should be replaced with trip-free breakers in the airplane model involved.

(3) When an operations manual is required for a particular model airplane, it should include information concerning identification and operation of any circuit breakers installed in the airplane.

(4) Prior to the certification of surplus military aircraft, circuit breakers or fuses installed therein should be changed, if necessary, to conform to the policy indicated, except that nontrip-free breakers may be retained in nonemergency circuits if trip-free breakers are not available, but only until trip-free breakers become generally available, at which time they should be replaced.

This new policy is effective immediately both on new model and surplus military model airplanes that have not yet been approved. Notes and comments accompany each of the foregoing policies. *Safety Regulation Release No. 191*, September, 1945.

Air Carrier Operations Specifications—Aircraft and Maintenance. To execute that portion of the Civil Aeronautics Act designated as Section 604(a), Operations Specifications covering various functions of the operation of a scheduled air carrier are issued by the Administrator as a part of the Operating Certificate. These Operations Specifications are divided into self-contained sections, such as Enroute Specifications, Aircraft Specifications, Maintenance Specifications, etc. The aggregate of all these various specifications comprises the terms, conditions, and limitations of the Operating Certificate.

Procedures and methods have been devised by which the Operations Specifications may be substantiated for readjusted terms, conditions, and limitations. Those procedures and methods are based upon the realization that the terms, conditions, and limitations may be subject to change with progress in the development and utilization of the aircraft.

Detailed instructions are given for the use of the following forms: Operations Specifications—Preface Pages, Forms 512 and 518; Aircraft Identification, Form 518-A; Engine and Propeller Maintenance, Form 512-A; Aircraft Maintenance, Form 512-B; Instruments, Form 512-C; General Information; Application to Amend Limitations Specified in Operations Specifications. More extensive data are required for substantiation of the following: Physical Inspection; Service Experience; Expected Functional Operation and Airworthiness Standard; Original Manufacturer's Recommendations. *Safety Regulation Release No. 192*, October, 1945.

Revision Pages for Civil Aeronautics Manual 04, July 1, 1944 Edition. Additional manual material has been made available for the July 1, 1944, edition of the Civil Aeronautics Manual 04. In addition, amendments have been made to the Civil Air Regulations, which in turn have affected the manual material in CAM 04. In order to assist in bringing copies of the Civil Aeronautics Manual 04 up to date, revised and additional pages have been provided to be inserted in copies of the manual.

The supplemental and superseding pages are 121 to 126-d inclusive, 147 to 147-b inclusive, and 150 to 150-b inclusive, superseding pages bearing corresponding numbers without the letter suffixes.

In each case where a page of the manual has been affected, the page has been reprinted in its entirety, incorporating the revised material. Thus, all such pages of the original manual which have been superseded may be removed and destroyed. *Safety Regulation Release No. 193*, October, 1945.

Issuance of "NX" Certificates. The purpose of this release is to advise applicants relative to the requirements and procedures governing the issuance of an "NX" Experimental Certificate in accord with the Civil Air Regulations Part 43.102(c).

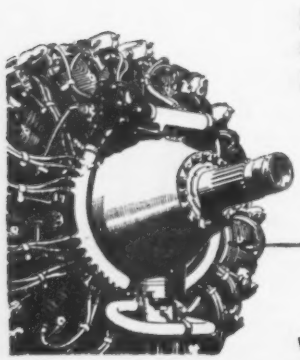
The fundamental purpose of NX certification is to provide for the operation of an aircraft that has not been shown to comply with the airworthiness requirements of CAR Part 04. Such operation is considered necessary to allow designers, manufacturers, and operators the widest possible latitude in the development of new aircraft or equipment prior to applying for type approval. Some of the typical circumstances under which Experimental Certificates may be issued are enumerated as follows: (1) Development of prototype aircraft or aircraft equipment with intent of obtaining type approval; (2) special design or unconventional types built for exhibition or racing purposes; (3) special investigations to determine the economic practicability of an operation of a particular nature.

World News
B-29 SETS DISTANCE RECORD
Superfort Flies Non-stop from Guam to Washington 8198 Miles in 35:05 Hours
CONSTELLATION IS CHOSEN BY EIGHT MAJOR AIRLINES
MARS HAULS 6-TON CARGO IN RECORD HOP TO NATAL
U. S. SPANNED IN 6 HOU
Stratocruiser Sets Transport Record
CONSTELLATION FLIE
TO PARIS IN 12:57 HOUR

The power behind the HEADLINES

Look at the records for speed, range, load and fleet efficiency. One engine dominates, one engine makes possible the headlines. One engine has the sheer power, low weight and low fuel consumption to make possible these headlines. It is the Wright Cyclone 18.

Many of the headlines tell of records with military planes—such as the Boeing B-29, Martin Mars, Consolidated B-32 or Boeing C-97. But now that the Cyclone 18 is fully available for commercial use in Lockheed Constellations and other transports, its power will make new records which will be reflected directly in earnings.



WRIGHT *Aircraft Engines*

AIR POWER FOR A WORLD AT PEACE

Wright Aeronautical Corporation, Paterson, New Jersey, U.S.A. • A Division of Curtiss-Wright

The operation of an aircraft displaying an NX Certificate will be so restricted as to preclude any apparent danger to the general public. The extent of the restrictions will depend upon the result of an inspection by the Civil Aeronautics Administration. Each application must be considered as an individual case with respect to the aircraft involved, the type and purpose of the operation conducted, the territory to be covered, the duration of the authorization, prevailing weather, etc. The duration of the certificate will be limited to the time estimated to be required for the experimentation involved. Operation under an NX Certificate may be extended to include demonstrations to prospective customers provided the aircraft or one similar has been flown for a period of 10 hours or more, and provided no maneuver is attempted that has not been previously successfully performed by the aircraft. Experimental equipment, such as radio, instruments, etc., may be tested on NC certificated aircraft without changing the certificate to NX provided the alteration involved to install such components does not adversely affect the flight characteristics or structural integrity of the aircraft.

Everything possible will be done to encourage legitimate experimentation which may lead to improvement in an aircraft design whenever this may be done without endangering the lives of persons or property not involved in the experimentation.

NX Certificates are usually issued by field office personnel. However, applications for an Experimental Certificate for the purpose of determining the economic practicability of operation of a particular nature should be submitted direct to the Civil Aeronautics Administration, Flight Engineering and Factory Inspection Division, Washington 25, D.C., with at least the following additional information: Minimum time required for experiments, proposed routes scheduled or number of flights to be conducted, crew required for the operation, aircraft weight, and any other pertinent information that may contribute to a complete understanding of the nature of the proposed experimentation. *Safety Regulation Release No. 194*, October, 1945.

Small Airports. Issued September 1, 1945, this bulletin contains current information and advice about the building of Class I and Class II airports. With a general outline of the varied problems involved in the planning, construction, and operation of small airports, specific answers to these problems are supplied. The text is divided into five main portions, the first dealing with planning of the airport; the second with its design; the third with construction; the fourth with operations and finances; and the fifth with maintenance. A list of regional offices of the Civil Aeronautics Administration, where further information can be obtained, is given. *Office of Aviation Information.* For sale by the Superintendent of Documents, Washington, D.C., $0.10.

Analysis of the Desire to Fly (D-F) Inventory. L. S. Kogan, M. J. Wantman, and J. W. Dunlap. A report is given on research conducted at the University of Rochester, by means of a grant-in-aid from the National Research Council Committee on Selection and Training of Aircraft Pilots, from funds provided by the Civil Aeronautics Administration.

The research project involved the voluntary cooperation of 46 psychologists in various parts of the country. These psychologists tested a total of 2,333 elementary and 717 secondary Civilian Pilot Training students and made available the results of examinations on a standard battery of tests for comparison with criterion data obtained from the C.A.A. and through the cooperation of coordinators in the Civilian Pilot Training Program.

The inventory contains 235 questions dealing with personal characteristics, opinions, habits, attitudes, and preferences. In selecting items for the test an attempt was made to secure those items which appeared to have a direct relation with the motives behind the student's desire to fly.

The aims of this analysis of the D-F Inventory were (1) to determine the selective efficiency of each item in terms of the criterion of passing or failing in flight training; (2) to develop scoring keys yielding maximum prediction of the criterion; (3) to investigate whether the questions tended to be answered "Yes" or "No" by a similar percentage of people in different samples; and (4) to determine the relationship between scores on the D-F Inventory and the scores on other tests in the battery of the Standard Testing Program. *Civil Aeronautics Administration, Division of Research, Report No. 50*, October, 1945.

Student Pilot Guide. Information has been prepared by the Examination Section of the Airmen Service of the Office of Safety Regulation of the Civil Aeronautics Administration to help students become safe pilots. The Guide contains information important to student pilots, particularly during the early stages of flight training; a summary of rules governing operation of aircraft (all the information necessary to pass the student-pilot written test); and some general suggestions for the student's further development in aeronautical knowledge.

It lists the pilot's privileges and restrictions; air traffic rules; specific flight areas; aircraft certification; aircraft inspection; private pilot certificate; safety practices and procedures; low-altitude flying; flight in poor weather; aerobatics; aeronautical knowledge. A list of publications of the C.A.A. dealing with the aeronautical knowledge that pilots should have is appended, with prices. *Office of Aviation Information.*

The Contribution of Psychology to Aviation. The addresses presented at the annual meeting of the Committee on Selection and Training of Aircraft Pilots of the National Research Council are compiled in a booklet of 26 pages. The titles of the addresses and the speakers are as follows: "The Aviation Psychology Program of the Army Air Forces," by Major Gen. D. N. W. Grant, Air Surgeon, Army Air Forces; "The Aviation Psychology Program of the U.S. Navy," by Commodore J. C. Adams, Chief, Division of Aviation Medicine, U.S. Navy; "The Role of Psychology in the Future of Civil Aviation," by W. A. M. Burden, Assistant Secretary of Commerce; "The Pattern of Research in the Aviation Psychology Program of the Civil Aeronautics Administration," by D. R. Brimhall, Assistant to Administrator of Research, Civil Aeronautics Administration; "The Aviation Psychology Program of the Committee on Selection and Training of Aircraft Pilots (Annual Report—June 30, 1945)," by M. S. Viteles, Chairman, Committee on Selection and Training of Aircraft Pilots. *Committee on Selection and Training of Aircraft Pilots, National Research Council.*

Civil Aeronautics Board

Revisions of Civil Air Regulations. Supplementing the release of September 27, 1945, the Board has announced a decision on two additional points of importance to manufacturers and operators of transport airplanes. These requirements, which will be covered in the revisions of Parts 04, 41, and 61 of the Civil Air Regulations, will be as follows:

(1) The steady rate of climb at 5,000 ft. with all engines operating at maximum continuous power and the airplane in the cruising configuration shall not be less in ft. per min. than 8 V_{s_0}. The operating rules will prescribe a rate of climb of 6 V_{s_0} at 1,000 ft. over the highest terrain en route.

(2) The operating rules will prescribe that an airplane with four or more engines will not be dispatched over a route, from any point along which more than 90 min. at the cruising speed to be used is required to reach a suitable landing area, at a weight greater than would permit a rate of climb with two engines inoperative; the remaining engines operating at maximum continuous power, of 0.01 $V_{s_0}2$ at an altitude of at least 1,000 ft. above the highest terrain en route, or 5,000 ft., whichever is higher. Compliance must be shown with this requirement either at the weight which the airplane shall have attained at the moment of failure of the second engine, not sooner than 90 min. after take-off, or at a weight which may be attained by dumping fuel while still retaining sufficient fuel aboard the airplane to reach the landing area. In computing this remain-

ing fuel it may be assumed that the flight will be completed at a height of 1,000 ft.

Report of Formal Economic Proceedings as of October 31, 1945. Tabulated data sheets contain lists and summaries of the proceedings of the Civil Aeronautics Board, giving reports of the progress made within the month of October, applications filed during the month, cases upon which decisions have been rendered, and other dispositions of cases. *Civil Aeronautics Board, Docket Section, Office of Trial Examiners.* For sale by Publications Section, $1.00 per year.

Economic Characteristics of Domestic Airline Stations, Certificated as of April 1, 1945. Statistics are given in the form of tabulations, based mainly on 1940 census figures, with regard to the economic characteristics of the communities in which are located stations of the domestic air lines certificated as of April 1, 1945. This is the second compilation of such information, the first having been based largely on 1930 census figures. The statistics deal with the ranking of 286 air-line stations with regard to population within the city limits and within a 25-mile radius of the air-line station, and comparisons with similar figures based on the 1930 census; number of persons gainfully employed within the radius; volume of post-office receipts; volume of retail sales; number of individual income-tax returns; and other data. The principal purpose of the current report is to provide newer, additional, and more precise reference data for use in future proceedings with regard to route applications and estimating potential air traffic. *Civil Aeronautics Board, Economic Bureau, Research & Analysis Division.*

Department of Labor

Wartime Development of the Aircraft Industry. Statistics regarding employment and productivity in the aircraft industry during the war are reprinted in a 23-page booklet. Numerous tables summarize the figures. The text gives a brief description of the industry, a review of the trends of employment, the distribution of employment, labor turnover, absenteeism, hours and earnings, and production trends. *Bulletin No. 800, Division of Construction and Public Employment, Bureau of Labor Statistics.* For sale by the Superintendent of Documents, Washington, D.C., $0.10.

National Advisory Committee for Aeronautics

Nondestructive Measurement of Residual and Enforced Stresses by Means of X-Ray Diffraction: Part II, Some Applications to Aircraft Problems. George Sachs, Charles S. Smith, Jack D. Lubahn, Gordon E. Davis, and Lynn J. Ebert. Tests on the use of X-ray diffraction methods for determining surface stress distributions in notched tensile bars and in the vicinity of a welded joint in aircraft steel tubing are described. Data on the effects of stress and degree of notching on the principal stresses and stress-concentration factors for flat notched tensile-test specimens were obtained. For the greater part the results confirm previous analytic and photoelastic determinations of those quantities. It was found that X-ray techniques were of limited value for determining the direction and magnitude of residual stresses in weldments since the condition of the metal was such as to prevent an accurate determination of the lattice parameters.

Among the problems interesting to the aircraft industry which might be subject to a commercial application of X-ray stress measurements are (a) the distribution of stresses under load in structures of changing section, or "notched" sections, and (b) the distribution of residual stresses in welded structures. While some investigations in these directions have been carried out previously, they are not sufficiently extensive to reveal the general applicability of the X-ray diffraction method to such problems.

Consequently, of these two groups of problems, one special problem in each group was selected. The investigation was particularly concerned with the reliability and accuracy of the stress measurements and their general usefulness. *Technical Note No. 987*, November, 1945.

Analytical Study of Transmission of Load from Skin to Stiffeners and Rings of Pressurized Cabin Structure. Theodore Hsueh-Huang Pian. The general problem of this paper is the deformation and the stress analysis of a pressurized cabin structure, consisting of sheet-metal skin, longitudinal stringers, and a finite number of rings which are equally spaced between two end bulkheads. The minimum potential-energy method is used. The deformations are calculated by solving the simultaneous difference equations, involving three deformation parameters—radial expansion of rings, quilting of stringers, and transverse elongation of skin. The tensile stresses of the rings and the stringers, and the longitudinal and the circumferential stresses of the skin are determined from the deformations. A few special cases from the general problem also are considered.

The results obtained during tests of pressurized-cabin structures by both the Lockheed Aircraft Corporation and the Consolidated Vultee Aircraft Corporation yield reasonable checks with the results from the theoretic analysis. *Technical Note No. 993*, October, 1945.

Table of Interplanar Spacings for Crystal-Structure Determinations by X-Ray Diffraction with Molybdenum, Copper, Cobalt, Iron, and Chromium Radiations. J. Howard Kittel. A widely used technique in X-ray-diffraction investigations consists in placing a powdered or small polycrystalline specimen in a Debye-Scherrer camera and allowing a beam of monochromatic X-rays to fall upon the specimen. A fraction of this primary beam of X-rays will be diffracted by the specimen. The diffracted rays leave the specimen in the form of cones, the axes of which are identical with the primary X-ray beam. The cones of diffracted X-rays, if allowed to fall on a sensitized film in a Debye-Scherrer camera, will produce a pattern of arcs which are symmetrical about the axis of the undeviated primary X-ray beam. If the dimensions of the camera and the wave length of the X-rays are known, it is possible to compute the spacings of the atomic planes of the crystalline specimen from the distances of the arcs from the primary beam. A knowledge of the interplanar distances will provide information, often not obtainable by other methods, regarding the crystal structure and chemical composition of the specimen, the identification of phases present, and the determination of grain size, solid solubilities, and the presence of internal and applied stresses.

For a simple diffraction pattern, the time required to calculate interplanar distances from measurements of the pattern is not excessive. If more than a few lines are present, however, or if several simple patterns are to be studied, it is advantageous to have available a table giving interplanar spacings directly in terms of the linear measurements made on the film of the lines appearing in the diffraction pattern. The preparation of such a table was undertaken at the N.A.C.A. Cleveland laboratory and the figures are given in this Technical Note with the necessary explanations. *Technical Note No. 1,000*, October, 1945.

Naval Air Station

Present Day Training in the Low Pressure Chambers at Pensacola. Lt. Comdr. Harald A. Smedal. A report is given of the progress made in training flight students with the aid of the low-pressure chambers installed at the Naval Air Station at Pensacola, Fla. The writer reviews the procedure used until 1943 and then describes the present practice. Brief information is given about the low-pressure equipment utilized at the station.

The Effect of Sunlight on Dark Adaptation. Lt. Comdr. Brant Clark and Lt. (j.g.) M. L. Johnson. Studies of the effects of exposure to sunlight are reported, with regard to the subjects' night vision after various experimental periods of exposure. The conclusions are summarized. *Contact*, publication of the School of Aviation Medicine, U.S. Naval Air Station, Pensacola, Fla., November 1, 1945.

Navy Department

Photography, 1945 Edition, Volumes I and II. As part of a series designed to provide enlisted men of Naval Aviation with the information necessary to perform their duties, these books impart the knowledge of photography required for the rank of Photographer's Mate. Volume I deals with the fundamentals of the subject and Volume II advances the student to the more specialized fields.

Volume I explains light and lenses, cameras, negatives, techniques, chemicals and solutions, development, printing, and the troubles experienced with negatives. Instructions concerning flash photography are followed by information about filters and infrared photography. The making of identification photographs is detailed. Copy work, portraiture, and group photography are explained, as well as lantern slides and the use of Pola screens.

Volume II explains color photography, aerial photography, stereoscopy, motion-picture photography, the care of photographic equipment, and the administration, regulations, and records pertaining to photography. An explanation of the theory of color work is followed by practical applications and numerous tables for the use of the color photographer. Cameras, films, processing, and techniques for aerial and motion-picture work are detailed.

The operation of motion-picture projectors is described. The handling of photographic apparatus under all conditions is outlined, and the Navy's photographic organization and procedure are described. *Prepared by Standards and Curriculum Division, Training, Bureau of Naval Personnel.* For sale by Superintendent of Documents, Washington, D.C., Vol. I, $0.60; Vol. II, $0.55.

Office of War Information

U.S. Government War Information Films. A catalog, dated July, 1945, lists all the O.W.I. 16-mm. sound films that are available to the general public. Concerned with the war either on home or fighting fronts, these films not only depict military, naval, and air events that took place, but also explain some of the issues of the war and describe the peoples who were the United States' allies or enemies.

Who may obtain the films and how they may obtain them are told in the introduction. Running time for each film is listed with its title. The motion pictures are classified under the following categories: Our Allies; The Nature of Our Enemies; The Farm Front; Our Fighting Forces; The Home Front; The Peace; The Production Front; and Rehabilitation. *Bureau of Motion Pictures,* Washington, D.C.

The Smithsonian Institution

Correlations of Solar Variation with Washington Weather. C. G. Abbot. The paper delivered May 31, 1945, before the Meteorological Section of the American Geophysical Union, at Washington, is reprinted in a 10-page booklet. It deals with the variations in the values of the solar content of radiation and their effects upon the magnitude and duration of temperature changes at Washington and other stations. *Smithsonian Miscellaneous Collections, Vol. 104, No. 13 (Publication No. 3807),* $0.10.

State of Vermont

Aeronautic Laws. Abstracts are given of the laws of the State of Vermont applicable to aeronautical activities. The sections of the 53-page booklet refer to airport development; legal status; operation of aircraft; penalties; Airport Zoning Act; State Aeronautic Department Act; Vermont Air Commerce Act. *Vermont Aeronautics Commission,* Montpelier, Vermont.

United Nations Information Office

War and Peace Aims. Special Supplement No. 6 of the *United Nations Review* contains a collection of extracts from statements of leaders of the United Nations, prepared in an attempt to meet the need for a convenient survey of official statements on war and peace aims made to date by the heads of state, the members of various governments, and authorized spokesmen. It does not attempt to give an analysis of policy.

The principal sections deal with the significance of the recent struggle; immediate postwar problems; prevention of future aggression; measures for prosperity; social and political problems; territorial problems and declarations on specific countries and territories; international organization. An annex contains reproductions of various official documents, such as the joint declarations of the United Nations, treaties, and agreements.

The current volume covers the period from January 15 to July 15, 1945. For sale by the United Nations Information Office, New York, $0.75.

U.S. Weather Bureau

Upper Air Average Values of Temperature, Pressure, and Relative Humidity Over the United States and Alaska. Benjamin Ratner. Information regarding the average upper-air temperature, pressure, and relative humidity has been prepared in answer to requests from the armed services, manufacturers and designers of aircraft, air lines, and various scientific organizations. The data were obtained by means of radiosonde equipment, based on observations taken at a group of 37 stations throughout the United States and its territorial possessions, and listed alphabetically. Temperature is shown in degrees centigrade, pressure in millibars, relative humidity in percentage, altitudes and station elevations in units of 0.98 geodynamic meter above sea level (approximately equal to one geometric meter, or 39.4 in.).

Tables are given for all months for all standard levels; temperature-height graphs for the months of January, April, July, and October; and charts depicting the temperature and pressure-distribution patterns for these same mid-months of each season, for altitudes ranging from 1,500 to 16,000 meters. *Climate and Crop Weather Division.*

War Production Board

Handbook of Standards for Describing Surplus Property. This handbook has been prepared for the purpose of establishing basic standards to be followed in describing surplus property when it is listed in inventory reports. It tabulates in a column headed "Information Needed," the minimum information that should be shown in preparing reports of surplus property, and tells how to describe such property for disposal purposes.

All of the tables relating to a major group of commodities are assembled in a section and the entire handbook is made up of 22 such sections, which are indexed. *Prepared for the Surplus War Property Administration by the War Production Board.* For sale by the Superintendent of Documents, Washington, D.C., at $0.10 to $0.15 per volume.

War Department

Review of Allied Military Government and of the Allied Commission in Italy. The functions and accomplishments of the Allied Control Commission in Italy are reviewed in an illustrated booklet of 126 pages. The record refers to the period from July 10, 1943, (D-day in Sicily), to May 2, 1945, the date of the German surrender in Italy. It traces the work of civilian and military occupation and gives a detailed report of the many problems that were met and overcome in the conquest and reorganization in that part of the war theater. *Public Relations Branch, Allied Commission, U.S. Army.*

British Information Services

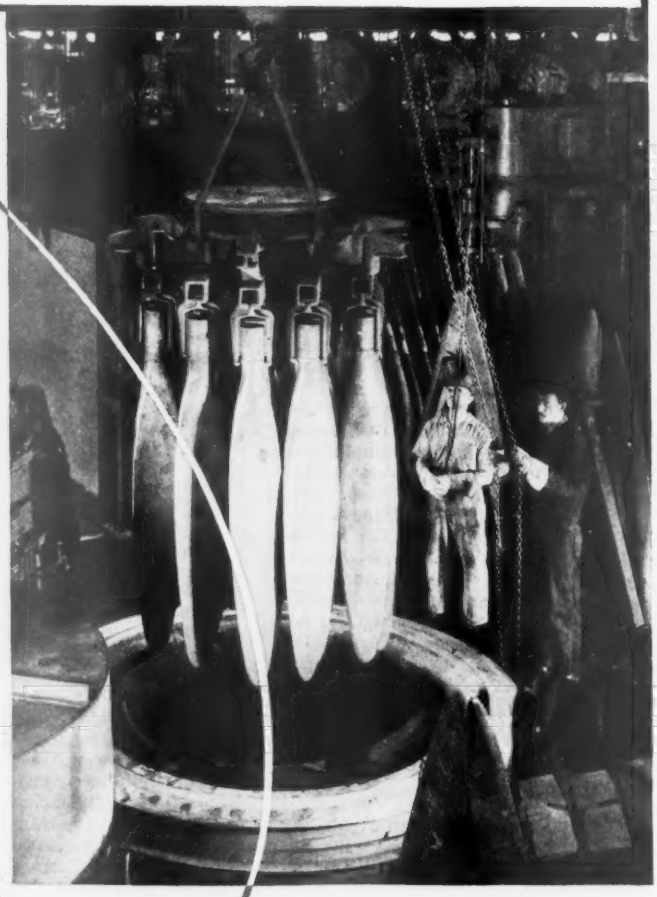
R.A.F. Middle East. The official story of British air operations in the Middle East from February, 1942, to January, 1943, is told in this pamphlet. The account is limited to the area in North Africa west of Cairo

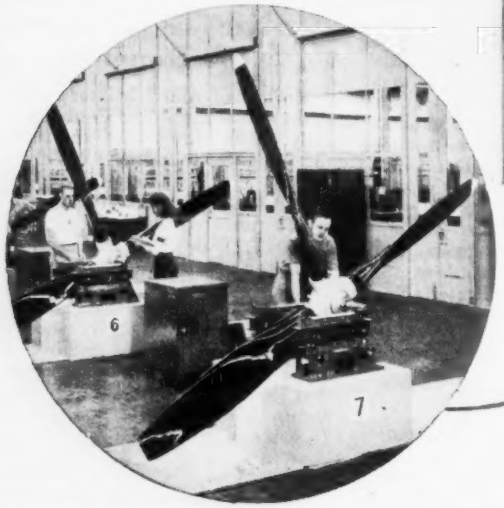
NICKEL STEELS *combine...*

EXCEPTIONAL MECHANICAL *and* FABRICATING PROPERTIES

SAE 4330 Nickel chromium molybdenum alloy steel was adopted for Curtiss propeller blades because of its high strength, toughness and good workability, coupled with a wide safe heat-treating range.

High velocity cooling is not necessary to properly harden SAE 4330 for this application. There is no warping to correct by cold-straightening operations nor danger from subsequent stresses that might cause failure in service, because the slow transformation rate of this steel permits hardening to the required degree by die-quenching; thus consequent savings in time and labor, and a uniform final product are provided.





Curtiss Propeller Division of Curtiss-Wright Corporation, one of the largest producers of constant speed propellers, fabricates blades by welding two plates of SAE 4330 into a hollow unit that permits weight saving over solid blades of light metals.

Inquiries on the use of Nickel alloy steels or other alloys containing Nickel in your products or equipment, are invited.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

and does not give any record of the work of the R.A.F. in Palestine or Iraq.

Interwoven with stories of exceptionally meritorious individual actions, the whole campaign is traced from the defeat of the large Italian ground and air forces through the epic defeat of Rommel and the clearing of enemy forces from North Africa.

The illustrations in the pamphlet are well chosen and show the extraordinarily difficult conditions under which all aircraft operated. *Prepared for the Air Ministry by the Ministry of Information.* For sale by British Information Services, New York, $0.29.

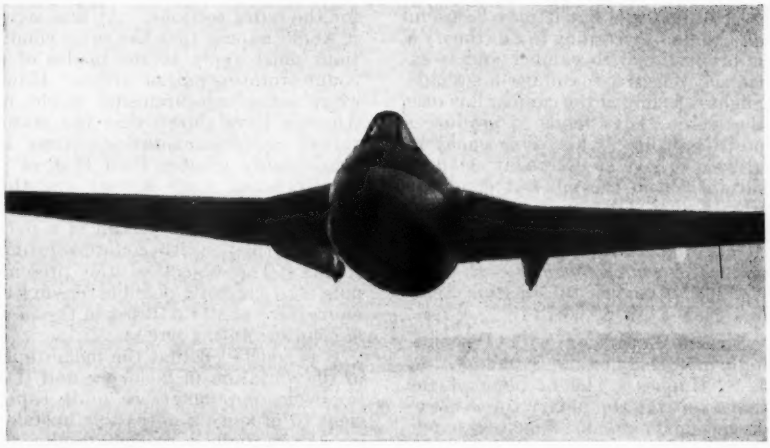
Britain Against Germany 1939–1945. The record of Britain's part in World War II is briefly outlined in a booklet of 128 pages consisting of pictures and descriptions of the important events of the war. The leading part taken by air power is emphasized by the fact that many of these chapters tell of the effectiveness of air defense of Britain in the early part of the war and the decisive results achieved by air power in the offense against the enemy.

Among the sections in which air power is featured are those telling of the Battle of Britain; Bomber Command Comes of Age; Enter the U.S.A.A.F.; The Breaching of the Mohne and Eder Dams; The Air Battle of Germany; The Robots; Royal Air Force 2nd Tactical Air Force; The Red Devils at Arnhem; Vergeltungswaffe-2.

The First To Be Freed. K. C. Gandar Dower. The record of British military administration in Eritrea and Somalia in the period 1941–1943 is set forth in an illustrated booklet of 72 pages. The effects of the first successful British campaign to free the peoples of North Africa from the domination of the enemy are traced. The subject deals particularly with economic and social conditions in these countries, the problems that were encountered, and the progress made in their solution. *Issued by the Ministry of Information.* For sale by British Information Services, New York, $0.30.

Films from Britain, 1945. A catalog of films from Britain made available in the United States by the British Information Services contains a listing of a large number of films giving information about a wide variety of British activities in industrial, commercial, agricultural, and other fields. The current catalog differs from its predecessors by combining the lists of specialized subjects of interest to professional, trade, and academic groups with the general films suitable for showing to any audience.

The films are intended to give an overall picture of the British people and their contributions to the Allied war effort, as well as other subjects of interest to those desiring information about British affairs.



The de Havilland Vampire jet-propelled interceptor, powered by the de Havilland Goblin turbine.

An Examination of Experimental Data Relating to Flexural-Torsional Wing Derivatives. J. Williams. Since the standard values suggested in *R. & M. 1782* for the local leading edge (or "fundamental") derivative coefficients were determined from experimental observations made in the early days of flutter investigation, the allocation of values to derivatives is reconsidered in the light of more recent results.

Part I examines available experimental data on flexural-torsional wing derivatives, obtained on airfoils at small mean incidences, and also for comparison reviews calculations made by W. P. Jones and P. Cicala, based on vortex sheet theory for finite rectangular wings. The notation used introduces the conception of "equivalent constant derivative coefficients," which in certain respects generalizes the usual simple assumption of local leading edge coefficients independent of the spanwise location. From the experimental data, a "mean experimental" set of local leading edge coefficients is determined.

Part II analyzes this and other sets of values in relation to critical flutter speed data available from tests on wings with linear taper.

In Part III conclusions are drawn, from the evidence at present available, concerning the influence of changes in Reynolds Number, frequency parameter, distortion modes, aspect ratio, taper ratio, and amplitude of oscillation, on the equivalent constant coefficients and local leading edge coefficients. A suggestion is also made for further derivative experiments. Until more definite results become available, the writer proposes certain values of the local leading edge coefficients for use with wings of normal aspect and taper ratios.

The derivative results are summarized, and the various sets of available local leading edge coefficients are tabulated. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1944.* British Information Services, New York, $1.35.

A Comparison of Hinge Moments of Flaps on N.A.C.A. 4412 as Determined by Theory and Experiment. J. H. Preston and T. W. Brown. It appears that the value of the hinge moment at no lift largely determines the stressing of the aileron control circuit in the pull-out from a dive for modern high-speed aircraft. There is not much experimental data available which is suitable for comparison with theory.

In earlier studies, however, the same section, N.A.C.A. 4412, has been utilized for extensive experimental and theoretic work on pressure distribution. These data have made it possible to make some interesting and useful comparisons between theoretic and experimental determinations. The results of these comparisons are described.

Serious scale effect on hinge moments as determined from pressure plottings on N.A.C.A. 4412 in the Variable Density Tunnel is confined to low Reynolds Numbers. It is at these Reynolds Numbers that scale effect on lift slope and angle of no-lift is most apparent, and it is also in the transitional region for drag variations. These scale effects are attributable to laminar separation at low Reynolds Numbers, followed by a "dead water" region or incompletely established turbulent flow over the rear of the airfoil. Small changes of lift slope are accompanied by large changes in b_1, which confirms a prediction made by Warsap and one of the writers of this paper. The experimental values are less than half of the theoretic values of b_1. It would appear that if the experimental no-lift angle agrees with the theoretic angle, then b_0, as determined from theory, will be in good agreement with experiment. The graphical differentiation necessary in the Theodorsen-Garrick method of calculating the theoretic pressures does not appear to be accurate near the trailing edge. Thin airfoil theory

overestimates b_0 but it may be useful as a guide. According to this theory b_0 is proportional to camber and is extremely sensitive to camber-line shape. Slight reflexing of the camber line near the trailing edge tends to produce a positive value of b_0. This could be utilized to give an extremely small resultant C_H in the pull-out condition from a dive. It would also have the advantage of giving a reduced $(Cm)_0$. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1960.* British Information Services, New York, $0.60.

Stream Expansion with Discontinuity in Velocity on the Boundary. N. J. S. Hughes. The problem of the shape of the boundary of a two-dimensional stream which expands along an infinite duct, with boundaries on which the velocity is constant, apart from a single discontinuity, is considered mathematically. The shapes of the boundaries are calculated for velocity ratios of 1.5 and 2.0. Physical realization of this type of flow would require boundary-layer suction at the points of discontinuity in velocity.

The exact shape of the wall near the discontinuity is considered in detail, in view of its mathematical interest, and turns out to be a closely wound infinite spiral. This spiral has no physical significance, as experimental realization of the flow would require the application of boundary layer suction at the discontinuity. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1978.* British Information Services, New York, $0.60.

Spring Tab Controls. W. S. Brown. In a recent paper Gates has pointed out the advantages of control fitted with a non-preloaded spring tab and has given a mathematical theory applicable to a particular design. In the present paper a basic theory is given applicable to all types of spring-tab controls and important features common to all are demonstrated. Part of the difficulty in designing such controls arises from the large number of variable parameters. Some of these are determined within close limits by considerations of size and the desirability of keeping the mechanism within the control surface, but others may vary over a wide range. A method of procedure is indicated, which, it is believed, simplifies the design problem. It is also shown that a favorable type of control column force to control angle distribution may be obtained by designing the control to be closely balanced, or overbalanced, when the spring is removed, i.e., when the tab is operating as a pure servo tab. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1979.* British Information Services, New York, $0.90.

On the Static Thrust of Contra-Rotating Airscrews. A. R. Collar. Under static conditions or at low rates of advance, the blades of a single propeller are often stalled, except perhaps for the outer sections. At first sight it would appear that the same conditions must apply to the blades of a counterrotating pair of screws. However, some measurements made in America have shown that the static thrust of counterrotating screws is considerably greater than that of a corresponding single screw; and the same conclusion has been inferred from the short take-off run of a particular airplane with counterrotating screws. The object of the present note is to suggest a possible reason for an increase of static thrust in the case of counterrotating screws.

It is concluded that the magnitude of the variation in incidence and the frequency parameter are quite sufficient to produce a noticeable unstalling effect, judged by the results of Denis and of Bratt and Scruton. On the other hand, the curve of variation of incidence with time is far from sinusoidal. The effect of this fact cannot be assessed.

It is probable that the disturbances of incidence experienced by the blades are more severe in the study than the approximate theory set out would indicate since, in theory, the blades are replaced by points, whereas in practice they have finite magnitude and the clearance between the trailing edges of the front blades and the leading edges of the rear blades is usually quite small. *Ministry of Aircraft Production, Aeronautical Research Committee R. & M. No. 1994.* British Information Services, New York, $0.40.

On the Periodic Effects Experienced by the Blades of a Contra-Rotating Airscrew Pair. A. R. Collar. The present paper discusses the effects of the oscillatory nature of the flow around the blades on the performance of a counterrotating propeller. The blade sections at a representative radius are developed into two infinite cascades in a plane and the two-dimensional flow in this plane is discussed. For simplicity the blade sections are replaced by vortexes with strengths equal to the circulations around the blades.

On this basis, it is shown that if the two screws are to absorb equal powers at equal rotational speeds, the mean circulations around the blades must be equal; however, this implies, for similar sections and equal chords, a coarser pitch setting for the front screw than for the rear. For this condition, the slipstream velocity has an oscillatory rotational component; its mean rotation is, however, zero.

In designing a counterrotating propeller the most obvious way of assessing mean values for the local wind speed and direction is to imagine the number of blades to become infinite, while the blade settings and solidities are maintained; the slipstreams are then uniform. In the numerical example given it is shown that this method is fairly good enough. Although the local thrust variations are of the order of ±20 per cent from their mean values, the latter are less than 0.5 per cent different from those given by the assumption of an infinite number of blades.

No account has been taken in the present paper of the vortexes shed by the blades as the circulation changes. It may be anticipated that their effect will be to reduce the magnitude of the oscillatory variations in thrust, etc., to a degree depending on the value of the frequency parameter. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1995.* British Information Services, New York, $1.05.

French State Department of Aviation

Étude Méthodique de L'Aile Trapézoïdale en Consideration du Décrochment Principes Généraux et Bases de Recherche (Systematic Study of a Trapezoidal Wing, in Consideration of the Tearing of the Flow; General Principles and Ground-Work for Research). André Dufaure de Lajerte. Preliminary research work undertaken in advance of the detailed investigation is described in a report of the treatment of the aerodynamic problem involved in the determination of the distribution of profiles for a trapezoidal wing. At large incidences of the wing this distribution should be such that progression of the tearing of the flow does not start on the tip of the wing, and that tearing of the flow for all profiles does not take place simultaneously near the condition of maximum lift of the wing.

Because this problem encompasses all questions pertaining to the trapezoidal wing, which has become the conventional type of modern airplane wing, it is of primary importance in wing design and construction. However, it has not yet been treated systematically as to its general effect. *Publications Scientifiques et Techniques du Secrétariat d'Etat a l'Aviation, Technical Note No. 1,* 1942.

Expériences sur l'Écoulement de l'Air Autour de-Maquettes d'Ailes ou d'Avions Étudié par on Procédé de Visualisation (Experiments on the Air Flow Around Small Wing and Airplane Models by Means of a Visualization Method). L. A. Sackmann. This report presents a new visualization method which the author calls "auto-inscription." It differs from conventional visualization methods in that the surface of the object under investigation is covered with a thin coat of paint which has been sensitized to react against a proper gaseous agent. When the object is exposed to this gaseous flow, the path of the flow is instantly imposed on the sensitive paint. In this way the tearing of the flow, extent of wakes, or zones of interaction are determined. These phenomena may be easily photographed.

According to the writer, this method has been successfully applied to small wing models of wings and airplanes, as well as to full-scale models, and some of these experiments are described in this report. The main study of these experiments is directed toward typical cases of interaction, such as that of wing and fuselage, and toward the effect of fixation methods of models in the wind tunnel. *Publications Scientifiques et Techniques du Secrétariat d'État a l'Aviation, Technical Note No. 2*, 1942.

Mesure de la Pression sur un Corps en Rotation Rapide et Applications (Gage to Measure the Pressure on a Fast Rotating Body and Applications). Edmond Brun and Jean Lafond. The authors describe a new type of pressure gage proposed to facilitate the study of pressure distribution on a surface that is displaced relative to the air. Such distribution is a means for determining the aerodynamic field in the proximity of the surface. In the case of a rotating body this study is complicated by the mechanical difficulties that arise in connection with the pressure gage. In order to secure satisfactory results, it is necessary that the connection of the plug socket of the gage be kept free from any leakage. However, the use of a fixed gage requires an airtight connection between the movable tube that is attached to the plug socket and the fixed tube attached to the gage. If too much force is used in making the connection airtight, a frictional moment is created, the connection will wear out quickly and may become a new source of leakage during rotation.

In order to remedy these shortcomings, the authors propose to replace the fixed gage that has the connecting piece with a gage that is solidly connected to the rotating body. In this way the pressure is measured on the rotating gage.

The report describes this new type of gage, as well as the first experiments during which this device was used. The writers believe that this rotating gage could also be applied successfully to other investigations, especially those on propellers, and in the study of the mechanics of fluids. *Publications Scientifiques et Techniques du Secrétariat d'État a l'Aviation, Technical Note No. 3*, 1943.

Polish Ministry of Industry, Commerce, and Shipping

Warsaw Airport. Plans for the development of a postwar civil airport in Warsaw are outlined in a 24-page booklet, which is supplemented with numerous drawings. A review is given of the air-transport facilities of Poland before the war, followed by a detailed presentation of the plans for building the new airport and its equipment. An estimate is given of the expected traffic volume, together with a description of the equipment required to provide the necessary traffic control and proper handling of the expected business. *Aeronautical Department, Polish Ministry of Industry, Commerce, and Shipping, London.*

British Air Ministry Translations*

The list below supplements those published in previous issues of the AERONAUTICAL ENGINEERING REVIEW.

Aeronautical companies and other organizations may borrow copies of these translations through the facilities of The Paul Kollsman Library upon application by the company librarian. Because of the importance of this material, the regular library loan period has been extended to two weeks, in order that these translations may be utilized to their full advantage. Requests should be made by number, author, and title on the regular Library book request cards. Because of the many requests for these translations, no more than five copies may be borrowed at one time by one organization.

The translations have been reproduced from typewritten copy, and the number of pages in each is indicated at the end of each reference. Bibliographic information has been taken directly from the translations. Photostatic copies are also available at the usual library rates.

2536A Annener Stahlwerke a.g. *Aircraft steel castings.* Contract terms for the delivery and acceptance of cast steel aircraft components. Report No. II. January, 1940. *General instructions for testing steel castings.* Report No. II. December, 1938. 10 p. Specification sheets for the inspection of cast steel aircraft components, and general contract terms for subcontractors, are outlined.

2536B Annener Stahlwerke a.g. *Development of airscrew hubs as centrifugal castings.* Report No. III. 7 p. Experiments were made on the casting of steel propeller hubs, using a new pattern with the thinnest cross-sections on the outside and thicker machining allowances toward the center. Of six molding materials used, only a sand and dextrine mixture, kiln dried at 160°C., was satisfactory. Fire clay and various sand and cement mixtures were unsatisfactory. No mass production by the method described was attempted.

2541 Germany. Reichsluftfahrtministerium. *Conditions of acceptance for aero engine oils.* Publication GL/A-MII, January 1945. 2 p. Specifications are given for German aircraft engine oils S3 and V2, with testing instructions.

2542 Encke, W. *Investigations on experimental rotors for axial fans.* Göttingen, Aerodynamic Experimental Institute, Gas Turbine Department, April, 1944. 15 p. Results are given of a series of tests on experimental rotors for axial fans. In addition to curves obtained for low and high peripheral speeds, construction sizes and blade sections for six different types of fans are given, and notes are added on fan construction.

2544 Schaferbarthold, H. *Two new methods of calculation for ascertaining the outputs and losses of groups of lines with limited availability in automatic telephone working.* Zeitschrift für Fernmeldtechnik Werk-und Gerätbau, v. 25, no. 1, January 15, 1944, p. 1–9. 16 p. Existing data are discussed for ascertaining the outputs and losses of groups of lines with limited availability. Two new methods of calculation are evolved and their results compared critically with actual values.

2545 Kostochkin, V. V. *Fuel tank protection by inert gases.* Tekhnika Vozdushnogo Flota, v. 17, no. 10–11, 1943. 8 p. The technical requirements are given for systems of protection of fuel tanks by exhaust gases, with the characteristics of operation and principles of design of such systems. An example is described of a system produced in the course of development tests on different aircraft types, which proved reliable under both summer and winter conditions. Recommendations for further improvement are specified.

2547 Weuthern. *Methods of measurement for the assessment of the efficiency of thermal de-icing systems on aircraft.* Göttingen, Institute for Low Temperature Research. Report No. 45/K/2, February 7, 1945. 17 p. With the method described, the author states that measurement of surface and air temperatures leading to evaluation of a deicing system can be made with a high order of accuracy. For the measurement of surface temperatures, thermocouples were found suitable, which had been rolled out to thin foils in the region of the soldered joint and stuck to the surface of the aircraft with varnish. Thermocouples for other temperature measurements are described. The various thermocouples were developed to reduce or eliminate the errors in measurement due to heat conduction and radiation. Thermoforces were measured with a Diesselhorst compensator in conjunction with a sensitive thread galvanometer, and accuracy within 0.1 to 0.2°C. was obtained.

2548 Turri, Albino. *The "Turri 43" parachute.* Figliaro, Como, July 26, 1945. 2 p. The parachute described consists of a ten-panel pilot parachute with a supporting surface of 0.637 m², and a lower twenty-panel parachute of 35.643 m². The total weight is 6.4 kg. It is stated that the parachute can be accurately guided, velocity of descent can be controlled, and it opens fully in 1.7 sec. Pneumatic shock absorbers reduce strain when the canopy fills.

2549 Askania-Werke, a.g., Berlin. *Measuring photo-theodolite.* July 21, 1937. 26 p. Cine-theodolite models Gtk 3d and Kth 40 are illustrated and described, suitable for measuring the path of bombs, torpedoes and sea mines, the trajectory of rockets, parachute drops, fighter aircraft maneuvers, and for calibrating instruments. Procedures and formulas for evaluating film pictures are outlined briefly.

* Selected translations are available in reprinted form (on 8½ by 11 paper) from the Durand Reprinting Committee, c/o Aeronautics Department, California Institute of Technology, Pasadena 4, Calif., at $0.05 per page. The translations are also available on a yearly subscription basis at $0.05 per page with a guarantee that not over 2,000 pages per year will be reprinted.

Clocks with tiny crystal hearts that beat 100,000 times a second

CRYSTAL HEARTS beat time in Bell Telephone Laboratories, and serve as standards in its electronics research. Four crystal clocks, without pendulums or escapements, throb their successive cycles without varying by as much as a second a year.

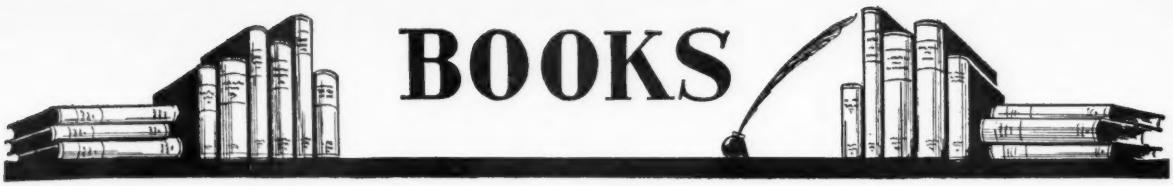
Precise time measurements may seem a far cry from Bell System telephone research, but time is a measure of frequency, and frequency is the foundation of modern communication, whether by land lines, cable, or radio.

These clocks are electronic devices developed by Bell Laboratories, and refined over years of research. Their energy is supplied through vacuum tubes, but the accurate timing, the controlling heart of the clock, is provided by a quartz crystal plate about the size of a postage stamp.

These crystal plates vibrate 100,000 times a second, but their contraction and expansion is submicroscopically small—less than a hundred-thousandth of an inch. They are in sealed boxes to avoid any variation in atmospheric pressure, and their temperatures are controlled to a limit as small as a hundredth of a degree.

Bell Laboratories was one of the first to explore the possibilities of quartz in electrical communication, and its researches over many years enabled it to meet the need for precise crystals when war came. The same character of research is helping to bring ever better and more economical telephone service to the American people.

BELL TELEPHONE LABORATORIES *Exploring and inventing, devising and perfecting for continued improvements and economies in telephone service.*



With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

General Marshall's Report: The Winning of the War in Europe and the Pacific

Contents: Victory in Europe: The Strategic Concept; The Fall of Italy; Operation Overlord. Victory Over Japan: The Road to China; Unremitting Pressure; Occupation; Our Weapons; The Troops; For the Common Defense.

The biennial report of the Chief of Staff of the United States Army to the Secretary of War refers to the period from July 1, 1943, to June 30, 1945. The introduction gives a summary of the factors that caused the enemy to fail in the achievement of victory over the Allied powers in 1942, when the situation is admitted to have been exceedingly grave. Information obtained from questioning captured enemy officers, as evaluated by the General Staff, is reviewed under the following headings: Failure to Invade England; The Campaign of 1941 in the Soviet Union; Stalingrad; Invasion of North Africa; The Invasion of France; The Ardennes Counterattack; The Crossing of the Rhine. A brief outline of Japan's objectives is followed by comments about the effects of the atomic bomb, and by quotations from General Arnold's report regarding United States air power. The introduction closes with a plea for the maintenance of a strong military establishment and the continuation of intense scientific research and development.

The main section of the report gives a detailed review of the operations in Europe and in the Pacific, showing how they were planned and carried out. Extensive comments are made about the important phases of the operations in North Africa, Italy, the landings in Normandy, the drive through the south of France, and the progress of the Allied forces on the Western and Eastern Fronts. The closing engagements and the collapse of Germany are reviewed at length.

In a similar manner the victory over Japan is traced through the widespread operations in the Pacific, in Burma, China, and India. The important battles and campaigns are described and related to the overall strategy as planned by the chiefs of the Allied Governments and the high commands of the Allied general staffs. The responsibilities of occupation and administration of captured territories are detailed, and a section tells about the weapons used by the victorious American forces. Statistics are included with regard to man power, casualties, awards for valor, and other facts. The closing sections of the report refer to personnel matters, Army management, problems of demobilization, and plans for the future. Large-scale maps illustrate the progress of the Allied forces in the various theaters of war.

Throughout the report, the contribution of air power is stressed, with details noted of the effectiveness of air operations and air cooperation with the other branches of the service. A special section of the report on the victory in Europe is given to the work of the air forces. Simon and Schuster, New York, 1945; 122 pages, $1.00.

Aviation Facts and Figures, 1945

Rudolf Modley, *Editor*

Contents: Production Facilities; Production; Labor; Finances; Military Aviation; Airlines; Personal Flying; Exports and Lend-Lease; Surplus Disposal and Contract Termination; Service Facilities; Training; Accidents; Aviation and Other Means of Transportation; Research and Development; Public Opinion on Aviation; Foreign Aviation Data.

Pertinent data and statistics on aviation as a whole have been collected by the Research and Statistics Service of the Aircraft Industries Association of America, Inc., and presented in this comprehensive analysis of the development of aircraft in the United States. Every page contains tables that show the vast scale to which the aircraft program of World War II evolved from small beginnings. The fundamental principle that air power consists of a combination of the aircraft industry, air commerce, and the nation's air forces is demonstrated by the statistical presentation, which shows the integration of all phases of national aviation.

This authoritative compilation, the first of a series, is an indispensable handbook for those who wish to have a detailed progress report of the aircraft industry, military and commercial aviation, and their allied services. McGraw-Hill Book Company, Inc., New York, 1945; 173 pages, $2.50.

The Wings of Warfare

Geoffrey D. M. Block

Contents: General Characteristics; A Short Chapter on Aeronautics; A Shorter Chapter on Engines and Performance; Concerning Construction; Producing a Warplane; The Three Combatant Powers in 1939; The War in the Air Unfolds; The Last Round; Concerning Bombing and Bomb-Stowage; Warplanes in 1939; Developments in Design; A Note on Terminology; The British Pattern; The United States Contribution; German Design; Italian Productions; Naval Requirements; Some Reflections on Air Power.

This survey of the employment of military aircraft by the Allied and Axis powers contains brief descriptions of the design, function, and accomplishments of well-known aircraft—English, German, Italian, and American. A more compact résumé of each type would be difficult to find. It is surprising that the author of a book containing so much aeronautical information as this study should not have attained to a higher rank than that of Corporal in the British Army. He had an opportunity to observe the war in the air, both in northwest Europe and the Mediterranean, and in his spare time he wrote this work.

The evaluations of the American airplanes used in the war are worthy of respectful consideration, even though they are critical. Hutchinson's Scientific and Technical Publications, London, 1945; 133 pages, 15*s*.

The Book of Miles Aircraft

Compiled by A. H. Lukins and *Edited by* D. A. Russell

The English aircraft company that has produced so many models that have brought it fame has its history from its start recorded in this book. The introduction gives a brief biog-

raphy of the founder of the enterprise, Frederick George Miles, and traces the company's contributions to the British aircraft industry. The remainder of the book contains a listing of each of the aircraft types designed and built by the Miles organization, supplemented by specifications, photographs, and three-view drawings.

Books of this type are most useful in giving an overall picture of the many types of aircraft that any company has to produce if it is to meet changing conditions. The Harborough Publishing Company Limited, Leicester, England, 1944; 88 pages, 10*s.* 6*d.*

Aviation

Devon Francis

Contents: Getting Acquainted with the Air; How an Airplane Flies; When You Learn to Fly; You Take to the Air; You Win Your Wings; A Plane Is Born; Power for Flight; They Guide the Way; Flying Weather; Highways of the Sky; The Rules of the Game; Silent Wings; Whirling Blades; Surgery for the Landscape; Air Nomads by the Wholesale; The Flying Future.

The young man or woman who wishes to learn to fly needs preliminary information. This book, written by one of the ablest aviation writers in this country, gives just such instructive facts.

The novice is told how an airplane flies, how it is made, and how it is operated. After a pilot solos he needs to know the rules of cross-country flying and the type of new experiences he may expect to have. All these, with many other useful suggestions, make the book an excellent gift for a prospective pilot.

In addition to the text material, the book contains a glossary and lists of aeronautical books, periodicals, organizations, and manufacturers of aircraft and engines. The book is one of the "What Everyone Should Know" series. The Bobbs-Merrill Company, New York, 1945; 229 pages, $2.50.

Handbook of Meteorology

Edited by Capt. F. A. Berry, Jr., Lt. Comdr. E. Bollay, and Lt. Norman R. Beers

Contents: Numerical and Graphical Data; Meteorological Mathematics and Calculations; Physics of Atmospheric Phenomena; Radiation; Meteorological Thermodynamics and Atmospheric Statics; Kinematics and Dynamics of Fluid Flow; The Scientific Basis of Modern Meteorology; Meteorological Instruments; Transmission and Plotting of Meteorological Data; Synoptic Meteorology and Weather Forecasting; Clouds and States of the Sky; Climatology; Hydrometeorology; Oceanography.

Practical meteorological information for the student and the professional meteorologist is supplied in this handbook. The scope of the present first edition is limited to aviation and hydrometeorology. It contains sections on fronts, air masses, upper air, etc., and also the fundamentals of mathematics and of the physical sciences upon which meteorology is dependent.

The volume has been written to meet the requirements for a convenient reference book and text containing data, fundamental theory, and the information needed for weather analysis and forecasting. Emphasis is placed on scientific and engineering aspects of the subject rather than on current techniques. McGraw-Hill Book Company, Inc., New York, 1945; 1,068 pages, $7.50.

Dynamics of Engines

F. S. Bauer

Contents: Motion and Force Analysis; Balancing of Forces and Couples; Cyclic Analysis of Forces, Torque, Energy; Torsional Vibration in Crankshafts; Lateral Vibration of Shafts; Problems.

Methods for investigating the dynamic characteristics of single- and multiple-cylinder steam, gasoline, and Diesel engines are described in this book. The in-line, V-block, and radial types of mechanisms are discussed. Graphical methods are employed in most cases. The subjects considered include kinematics of the engine mechanism, static and dynamic forces, balancing, flywheel characteristics, torsional vibration and critical speeds of crankshafts, lateral vibration and critical speeds of shafts, harmonic resonance, and vibratory stresses. A set of problems is included. University of Colorado, Boulder, Colo., 1944; 92 pages, $1.45.

War Neuroses

Roy R. Grinker and John P. Spiegel

Contents: Introduction; Clinical Syndromes; Psychiatric Problems in the Air Forces; Etiology; Prognosis; Treatment and Results; Psychobiologic Dynamics.

The case reports and conclusions set forth in this book are the results of the authors' personal observations of hundreds of patients suffering from war neuroses among American and British Ground Force and Air Force personnel, including the Army Air Forces. In explaining psychosomatic disturbances the authors have abstained from the use of preconceived theories. They believe, however, that all the observed phenomena have both a physiologic and a psychologic dynamic basis. Techniques of therapy and typical methods of dealing with anxiety are described. Detailed accounts of rehabilitation of the personality under the "psychotherapeutic" method of the authors are included. The Blakiston Company, Philadelphia, 1945; 145 pages, $2.75.

Aircraft Production Design

James E. Thompson

Contents: Designing for Production; Serviceability of Designs; Repair as a Factor in Design; Lubrication as a Factor in Design; Materials for Airframe Construction; Designing for Machineability; Drilling, Reaming, Counterboring and Threading; Turning, Boring and Grinding; Milling and Broaching; Sand and Permanent-Mold Castings; Die, Pressure Mold and Centrifugal Castings; Forgings; Wood Airframe Parts; Fusion Welding; Resistance Welding, Brazing and Soldering; Cutting and Bending Sheet Metal Parts; Forming Sheet Metal Parts; Drawing Sheet Metal Parts; Standard Parts and Designs.

A book written to provide the aeronautical draftsman and designer with a better understanding of the tools and processes used in the manufacture of aircraft parts, and to enable the designer to produce designs embodying the greatest possible manufacturing practicability and economy. The data were first collected for the author's personal use, later published in magazine articles, then presented in a course on aircraft production design sponsored by the University of California, and finally revised and amplified to form the text of this book. Aviation Press, San Carlos, Calif., 1945; 238 pages, $5.00.

Middle East 1940–1942

Philip Guedalla

One of the most prolific of English writers was commissioned in the Royal Air Force and asked to write the story of the air war in the Middle East. Although a student of other forms of warfare, he had never flown before. His history may, therefore, be said to reflect the point of view of an independent and impartial observer.

For illuminating background there is an excellent account of the beginnings and development of the British air forces that finally became the Royal Air Force. The work of air power in policing the Middle East is sketched, showing how it was used as a basis for protection of Iraq, Palestine, and Egypt when war came.

Except for the battles in North Africa, the fighting of the R.A.F. in the Middle East was obscured by the more important war activities on other fronts. This book places in proper perspective the importance of

the earlier work of airmen in keeping Syria out of German control and protecting the lines to the oil fields in Iraq and Iran. With obsolete aircraft the R.A.F. kept the countries east of Cairo subdued until North Africa was cleared of Italian and German forces.

This history has been written from information secured at first hand and should provide one of the most reliable sources for evaluating the results of air power in warfare in minor theaters of operation. Hodder and Stoughton Limited, London, 1944; 237 pages, 10*s*. 6*d*.

Book Notes

Big Distance, by Capt. Donald Hough and Capt. Elliott Arnold; Duell, Sloan and Pearce, New York, 1945; 255 pages, $3.00.

Two Captains of the Army Air Forces, each of whom has written novels, were assigned by General Kenny to record the history of the Fifth and Thirteenth Air Forces in their advance from Australia to Leyte in the Philippines.

Interwoven are stories of individual and group combat, and a description of each point reached as progress was made toward Japan. The stories paint a broad picture of jungle fighting, rescues from inaccessible locations, and air combat. The attack on the oil center of Balikpapan is described by men who participated in this long and successful raid.

The book, by limiting itself to the work of the two units, outlines a phase of the war which is unique, that of capturing one airfield after another on Japanese-held islands, bypassing other strongly defended enemy positions, and finally reaching the objective of a line of communication which eventually led to the Japanese homeland.

No account of this air operation has yet given such a clear picture of the work of the airmen under General Kenny.

A Dictionary of R.A.F. Slang, by Eric Partridge; Michael Joseph Ltd., London, 1945; 64 pages, 6*s*.

An authority on the history of slang, who is also the author of several books on the general subject of expressive words and terms, has gathered in this book the better-known slang words and phrases used by British airmen. Since many of the terms used have been adopted by the men of the U.S. Army Air Forces, the book will provide a key to an understanding of the "odd" language of airmen, and its derivations.

Although the slang vocabulary of airmen is much smaller numerically than that used in the Army or Navy, it has made a vigorous beginning and from now on dictionaries of this type will become more and more necessary to a complete comprehension of aviation speech.

The Logic of War, by Murray Harris; George Allen & Unwin Ltd., London, 1944; 146 pages, 10*s*. 6*d*.

Written by a Squadron Leader of the Royal Air Force, this study of the strategic concept of warfare is particularly free from any bias in favor of aircraft.

The author bases his conclusions on the idea that strategy is the study of communications. He develops this thought by applying it to all theaters of operation in World War II, and shows how the life lines of all the warring countries were dependent on supply and communication by air.

Atom Smashers, by Raymond F. Yates; Didier, New York, 1945; 182 pages, $2.00.

For those interested in a history of the study of the atom and the development of atomic power, this book gives in nontechnical language an understandable account of that scientific achievement. It includes background material contributing to a better knowledge of this force which has such great potentialities.

Aircraft Paintings of C. Rupert Moore; The Harborough Publishing Company, Ltd., Leicester, England, 1945; 16 pages, 21*s*.

These paintings, each with individual explanatory text, follow the history of the development of British aircraft types from the famous B.E.2C to the Horsa gliders.

Generally, artists who paint pictures of aircraft strive to emphasize one of three effects. Some wish to convey their impression of airplanes in action without regard to detailed accuracy of the machine. Others combine meticulous accuracy with artistic values, while another type of artist is almost photographic in his delineation. These paintings are in the second class. They are technically correct, show the aircraft engaged in its principal vocation, and display a wealth of color which establishes the artist as a master of the brush.

The colored reproductions are beautifully printed and the book is actually an art portfolio.

Invasion Aircraft: Friend or Foe? compiled by the Staff of the *Aeroplane Spotter;* Temple Press Ltd., London, 1944; 40 pages, 1*s*. 6*d*.

Photographs and details of the chief combat aircraft of the Allied and Axis powers are given in this small pamphlet, which is another useful aid for aircraft-identification observers. It gives tabulated recognition features classified according to the service for which the aircraft are designed, followed by alphabetical listings of the type names.

Now that the war is over these books will serve a useful purpose in preserving the record of the various types of aircraft used in the conflict.

Almighty Atom, by John J. O'Neill; Ives Washburn, Inc., New York, 1945; 94 pages, $1.00.

A clear and concise explanation of atomic energy and its present and possible applications is supplied in this pamphlet written by the Science Editor of the *New York Herald Tribune*. Technical intricacies are avoided as much as possible, yet an understandable description of this newly revealed force of nature is given.

Algiers, 1941–1943, by Renée Pierre-Gosset, translated from the French by Nancy Hecksher; Jonathan Cape, London, 1945; 260 pages, 10*s*. 6*d*.

A Frenchwoman who had excellent sources of information as to what was occurring behind the scenes in Algiers before and after the Allied invasion gives in this book a running account of her observations and opinions. She analyzes Franco-American relations as they were affected by the actions of our diplomats and the military in North Africa. She evaluates the results of applying American foreign policy on this first French soil to be freed.

Criticism of our State Department and our diplomatic representatives is made freely but it is admitted that rarely in the long history of France has any people been so popular as the Americans during the last 3 years.

Admiral Wags, by Fanny Jessop Sherman; Dodd, Mead & Company, New York, 1944; 84 pages, $2.25.

The wife of Rear Adm. Frederick C. Sherman, who commanded the aircraft carrier "Lexington," tells the story of their cocker spaniel which went through the historic battle of the Coral Sea and survived the sinking of that famous ship.

The dog's story is highly personalized and is told as though he were a sailor who could observe and recount with all the faculties of a human being. The development of the tale with its thrilling climax and its unique point of view will afford pleasure to young and old, appealing particularly to all dog owners.

The Dutch Navy at War, by A. Kroese; George Allen & Unwin Ltd., London, 1945; 131 pages, 6*s*.

The Dutch Navy had only a small air service, consisting mainly of PBY Catalina flying boats and three-engined Dorniers. The first-line equipment comprised nine flights, each having three flying boats. They were used for bombing and reconnaissance. Despite its limited numbers and lack of fighter protection, the Dutch Air Service won honors in the battle for the Indies.

The Dutch Navy lost about two-thirds of its original strength in the war. This small book records the

battles fought for the protection of Dutch colonies in the Far East.

Ribbons and Medals, by Capt. H. Taprell Dorling; George Philip & Son, Ltd., London, 1944; 197 pages, 8*s.* 6*d.*

A new and revised edition of a standard work first published in 1916. Its purpose is to provide a means whereby an ordinary person may recognize the medals or ribbons worn by officers and men of the various British armed services.

Flying Fitness Through Flights of Fun, by S. Ernest Tregurtha; Link House Publications Ltd., London, 1945; 65 pages, 3*s.* 6*d.*

Four hundred athletic activities that can be carried on, without using apparatus, for the physical training of cadet units and airmen are described in this pamphlet. It is intended to be a guide for the instructor of physical training by giving him many variations of the usual setting-up exercises.

Recreational training, general athletics, and swimming exercises are included in the routines suggested. The instructions are given in the form of brief descriptions of the different exercises and numbered sketches illustrating the principal movements.

Science and the Planned State, by John R. Baker; The Macmillan Company, New York, 1945; 120 pages, $1.75.

A leader in the cause of freedom of scientific investigation from state control gives the case of the scientists on the controversial subject of how far governmental control would impede the general advancement of science.

There are two opposing points of view on this problem, which has been brought to the fore by the use of atomic energy. The author champions with sincere conviction his side of the debate.

Railways, Ships and Aeroplanes; Odhams Press Limited, London, 1945; 320 pages, 9*s.* 6*d.*

The aircraft section of the book has been prepared by Capt. Norman Macmillan, which gives assurance of its authenticity. Through text and pictures he tells the story of the development of aircraft, air navigation, air liners, and airports.

The book in its entirety gives a broad overall history of the progress of transport by land, sea, and air.

A.B.C. of Aeroplane Spotting, by Haynes; Raphael Tuck & Sons Ltd., London, 1944; 16 pages, 3*s.* 6*d.*

The methods for acquiring a knowledge of identification of aircraft have had many variants. In this book, caricature is used to make special features stand out vividly. Under each sketch of a well-known airplane is an amusing drawing in color with a nickname making each type of plane easy to remember.

The purpose of the book is to amuse as well as to instruct, and thus to encourage still more people to become aircraft "spotters."

A Miniature History of the War, by R. C. K. Ensor; Oxford University Press, London, 1945; 94 pages, 3*s.* 6*d.*

Until definitive histories of World War II can be written, short outlines will have to serve. This short summary gives an overall record of the war to the time of the liberation of Paris.

It includes a table of important dates, and maps of the Western Front, the Mediterranean, the Russian Front, and the Pacific.

Lower Deck, by Lt. John Davies; The Macmillan Company, New York, 1945; 186 pages, $2.00.

The destroyer forces of both the British and American Navies rendered invaluable service to the Allied Air Forces. They made innumerable rescues of airmen and brought them back to active duty. An officer candidate serving with the crew describes life on a British destroyer. The book is a tribute to the heroism of the common seaman in some of the fiercest action of the war.

48 Million Tons to Eisenhower, by Lt. Col. Randolph Leigh; The Infantry Journal, Washington, D.C., 1945; 179 pages, $2.00.

The logistics of World War II are so stupendous as to render complete comprehension difficult. This book, compiled by the Historical Section of the Services of Supply gives some idea of the volume of war material transported to the European theater of operations.

The requirements of the Army Air Forces alone were great. The use of airplanes for transport reached unprecedented proportions. Their employment in evacuation was notable

One of the statistical charts in the book shows that the Air Forces received 82.32 per cent of all the awards and decorations in the European Theater of Operations. Other charts and tables, as well as the text, give statistical data concerning the quantities of material sent to Europe during World War II, and comparisons with the figures for World War I.

Airgunner, by Francis Jackson; A. H. and A. W. Reed, Wellington, New Zealand, 1944; 164 pages, 8*s.* 6*d.*

The story of "Everyman" in the Royal Air Force is told by this New Zealand writer, in following the career of a typical New Zealand Flying Officer in his training under the Empire Air Training Scheme and his subsequent operational flights over Germany and North Africa.

He tells of crashes on land and sea, the loss of friends, air raids on London, and the deadly intensity of the men of the R.A.F.

The Complete Flying Course, by Wing Comdr. N. Roy Harben; George Newnes Limited, London, 1944; 96 pages, 10*s.* 6*d.*

Designed to assist the flying instructor and to speed up the training of the pupil, this book is written in the form of air and ground lessons explained in simple and direct language. It is particularly intended for students selected for pilot training in the R.A.F.

Radio for Aeroplanes, by D. Hay Surgeoner; Longmans, Green and Company, London, 1944; 122 pages, 3*s.* 6*d.*

The purpose of this book is to provide the radio operator and radio mechanic with a knowledge of the principles of radio communication. The first chapters provide fundamental information about electricity, magnetism, thermionic tubes, and radio transmission and reception. Following chapters deal with the principles of direction finding, beam approach, and aircraft radio equipment.

Vector Methods Applied to Differential Geometry, Mechanics and Potential Theory, by D. E. Rutherford; Oliver and Boyd, London, 1944; 135 pages, 5*s.*

This book is designed to provide the reader with a knowledge of the vector algebra and vector calculus used in the various subjects usually taught to students preparing for a degree in mathematics. A chapter on differential geometry introduces the reader to the study of this subject by the methods of vector algebra, and this is followed by a section that shows how many aspects of the theory of mechanics are adaptable to the use of vectors. A discussion of the vector operator "nabla" leads to a treatment of the Potential Theory and Laplace's equation. This includes applications to the theories of gravitation, hydrodynamics, and electricity. There is also a short chapter on four-dimensional vectors.

Japanese-English Glossary of Electrical and Electrocommunication Terms, by Stanley Gerr; G. E. Stechert & Company, New York, 1944; 205 pages, $2.50.

Originally prepared for the U.S. Army Signal Corps, this Japanese-English dictionary of general electrical and electrocommunication terms includes radio, telegraphy, and telephony phraseology. Arrangement of the terms is in the traditional Chinese-Japanese character dictionary order, with the exceptions provided by the presence of elements in the middle of a term, where they are disregarded for filing purposes. For actual translation work, it is advised that the volume should be supplemented by other more general reference works.

How to Organise a Club for Aeromodellers; The Association of British Aeromodellers, London, 1945; 28 pages, 1*s.*

A guide intended to aid model-airplane builders in the formation and

running of local clubs. Information is supplied about the functions of officers, the club budget, rules and regulations, and other subjects connected with club organization and operation.

A Course of Study for the Senior High School Aeronautics Department, by R. B. Phillips; Industrial Arts Department, Duval County Public Schools, Jacksonville, Fla., 1945; 36 pages.

This booklet contains the course of study used in the senior high school aeronautics department of the Duval County public schools, Jacksonville, Fla. Sections are devoted to nomenclature, repairs, overhaul, alteration, maintenance, Civil Air Regulations, meteorology, and navigation.

The Complete Observers' Astro-Navigation, by Francis Chichester; George Allen & Unwin Ltd., London, 1944; 151 pages, 10*s*.

In writing this book the author's objective has been to aid the observer in learning sufficient astronavigation for position fixing in the air. Step-by-step explanations of necessary procedures are supplied. These show exactly what must be done to fix the position of an aircraft and give the reason for performing each act. The book also is intended to serve as a refresher for those who have already learned astronavigation.

Aeronautical Training, by Charles A. Zweng; Pan American Navigation Service, North Hollywood, Calif., 1945; 252 pages, $3.00.

Especially written to prepare the private and commercial pilot for the Government examination, this revised edition includes the section on Civil Air Regulations rewritten to include 1945 amendments. Another feature of the new edition is a complete section dealing with the required flight maneuvers and points in each maneuver on which the applicant is checked and graded. Typical multiple-choice examinations are included, for Civil Air Regulations, Aircraft, Aircraft Power Plants, Meteorology, and Navigation.

Aircraft and Engine Mechanics' Manual, by Charles A. Zweng; Pan American Navigation Service, North Hollywood, Calif., 1945; 230 pages, $3.00.

The eleventh edition of a book especially written to prepare mechanics applying for engine and aircraft ratings. Included are the Civil Air Regulations pertinent to the respective ratings. Procedures governing minor and major repairs, including alteration, are described and illustrated. A new section is included, concerned with weighing procedure and center-of-gravity location. Typical multiple-choice examination questions deal with the different phases of the C.A.A. written test.

Astronomical Air Navigation, by Squadron Leader Ronald Hadingham; Thomas Y. Crowell Company, New York, 1945; 151 pages, $2.50.

A revised edition of a course in astronavigation, written for practical air navigators. The text contains only essential references to mathematical and theoretic aspects of the subject. Information is included about two instruments, the Mark XA sextant and the astrograph, which have aided air navigation during the war.

Elmore at W.T.S., by Theodore J. Ritter and Robert W. Gadbois; The Dietz Press, Inc., Richmond, Va., 1944; 98 pages, $1.00.

Elmore at Pre-Flight, by Theodore J. Ritter and Robert W. Gadbois; The Dietz Press, Inc., Richmond, Va., 1944.

Elmore at Primary, by Theodore J. Ritter and Robert W. Gadbois; The Dietz Press, Inc., Richmond, Va., 1944; 126 pages, $1.00.

Elmore Intermediate, by Theodore J. Ritter and Robert W. Gadbois; The Dietz Press, Inc., Richmond, Va., 1944; 136 pages, $1.00.

Four additional books of the Elmore series chronicle the experiences of an "average" Naval Aviation cadet. Through the medium of humorous drawings, the reader follows the cadet through four of his training sequences. One volume deals with the second phase of his training, War Service Training; another with the third phase, preflight school; another with the fourth phase, primary training; and the last with the fifth phase, intermediate training. All of the books are of the loose-leaf type.

Geography of an Air Age, by E. G. R. Taylor; Royal Institute of International Affairs, New York, 1945; 55 pages, $0.25.

One of a series of pamphlets on reconstruction, published by the Royal Institute of International Affairs, London. It deals with geography and geographic relationships as applied to aviation, particularly world airways and great-circle routes.

Wings for Peace; The Labour Publications Department, London, 1944; 22 pages, 3*s*.

One of a series of pamphlets on a wide variety of political and economic subjects discusses the problem of how civil aviation should be organized and controlled in the future.

The Stromberg Flow Bench, by Charles H. Fisher; George Newnes Limited, London, 1944; 55 pages, 3*s*. 6*d*.

This book deals with the special test apparatus designed for use with the Stromberg injection carburetor.

While the flow bench cannot be used for making complete flow tests of the float-type carburetors as it does of the injection model, certain components of the later float carburetors are tested and adjusted on this apparatus. These notes, therefore, deal chiefly with the tests of the injection carburetor, but the description of tests applied to the automatic mixture control apply also to the units fitted in the later type of float carburetors.

These data are issued under the direction of the Ministry of Aircraft Production by the British licensees, The Zenith Carburettor Company, Ltd.

The Junior Officer's Handbook of the Theory of Navigation, by William Alexander; George Allen & Unwin Ltd., London, 1944; 108 pages, 2*s*.

One of a series of books on navigation and meteorology, this manual is concerned with primary principles of navigation. In it, sufficient plane and spherical trigonometry is given to explain the difference between plane and great-circle sailing, and sufficient nautical astronomy is included to interpret the theory behind celestial navigation. Nine chapters take up the subjects of plane trigonometry, spherical trigonometry, plane sailing, great-circle sailing, the celestial sphere, time, zenith distance and altitude, the Marcq St. Hilaire method, and latitude.

The Language of World War II, compiled by A. Marjorie Taylor; The H. W. Wilson Company, New York, 1944; 94 pages, $1.25.

An alphabetical listing of abbreviations, captions, quotations, slogans, titles, terms, and phrases used during, and with reference to, World War II. Supplementary to this list are two others—one an index of World War II war-song titles, the other a bibliography referred to as sources of information in the text.

Directory of Member Institutions and Their Principal Fields of Research; Engineering College Research Association, Austin, Tex., 1945; 92 pages, free.

A directory listing the schools that are members of the Engineering College Research Association, the names of the engineering research divisions of each, the director and other research officers, and the principal engineering fields in which each university or college is particularly well equipped.

Modern World Politics, by Thorsten V. Kalijarvi and Associates; Thomas Y. Crowell Company, New York, 1945; 852 pages, $3.75.

The second edition of a study of the facts and conditions affecting international relations contains the following revisions: (1) new chapters on "Nationalism and Minorities in World Politics"; "Relation of State and World Politics"; "Diplomacy and Power Politics"; "Aeropolitics"; "Education and World Politics"; (2) elimination of five of the original chapters in favor of the aforementioned new chapters; (3) extensive changes in all but two of the remaining chapters; (4) the addition of numerous pages of large-scale maps, to each of which reference is made in the text.

In its new form, the volume is divided into four main sections titled (1) Fundamentals of International Relations; (2) Techniques and Instruments of Power Politics; (3) The Great Regions in World Politics; and (4) Peace in Our Time? A total of 34 maps accompanies the text.

Planning of Science; Association of Scientific Workers, London, 1944; 127 pages, 2*s.* 6*d.*

Proceedings are reported of a conference held by the Association of Scientific Workers in London during January, 1943. The conference consisted of a series of papers and discussions dealing with the means and methods by which science should be planned. The first session considered the subject of central direction of science; the second, local organization; and the third, determining the future.

Tables of Associated Legendre Functions; Columbia University Press, New York, 1945; 303 pages, $5.00.

Compiled to meet the need for tables to about six significant figures at intervals of 0.1, this tabular material relating to the associated Legendre functions was prepared by the Mathematical Tables Project, conducted under the Sponsorship of the National Bureau of Standards. The present volume of mathematical tables was begun under the auspices of the Work Projects Administration for the City of New York and completed with the support of the Office of Scientific Research and Development.

Celestial Navigation, by Elbert F. Blackburn; The Infantry Journal, Washington, D.C., 1944; 122 pages, $1.00.

One of a group of manuals which has been prepared for the instruction of flight and ground crews, and originally published by the Airlines War Training Institute. It is intended for the use of the student and instructor in the classroom. The fundamental principles of celestial navigation are explained with the aid of diagrams and sketches.

Electronics for Electricians and Radio Men; Coyne Electrical School, Chicago, 1945; 426 pages, $4.95.

Coyne Electricians Handbook; Coyne Electrical School, Chicago, 1945; 348 pages, $2.75.

150 Coyne Shop Prints and How to Read Them; Coyne Electrical School, Chicago, 1945; 210 pages, $1.95.

Coyne Electrical and Radio Dictionary with Symbols; Coyne Electrical School, Chicago, 1945; 172 pages, $1.00.

These four books have been issued to aid electricians and radio men, including those working in the field of electronics.

Electronics for Electricians and Radio Men is an instruction and reference book written primarily to provide a broad picture of the electronics industries as they exist today. It describes present methods and practices. Information is supplied about electronic controls; measurements and processes for manufacturing; and commercial and home installations.

The Coyne Electricians Handbook contains essential formulas; charts; tables and code rules and their interpretation; and wiring methods for practicing electricians.

150 Coyne Shop Prints and How to Read Them is composed mainly of selected shop prints and diagrams of motors, controllers, starters, generators, compensators, transformers, and other electrical and radio equipment, accompanied by explanatory material.

The *Coyne Electrical and Radio Dictionary* contains definitions of electrical, radio, and electronics terms, expressions, illustrations and symbols.

John Bull Gets Tough, by S. F. Ferguson; Oswald-Sealy, Ltd., Auckland, N.Z., 1944; 68 pages, 2*s.* 6*d.*

An analysis is given of the characteristics of the people of the British Empire which have enabled that nation to achieve eventual victory in its wars up to the present time. It reviews the achievements of Great Britain in war production, in the training and use of armed forces, and in cooperation with its Allies in the recent war.

One chapter contains statistics about the production of aircraft and the accomplishments of the R.A.F.

Table of Arc Sin x; Columbia University Press, New York, 1945; 121 pages, $3.50.

Prepared by the Mathematical Tables Project, this is a table of twelve-place values of arc sin x in radian measure. It may also be used for obtaining the inverse cosine. The intervals of the argument were so chosen that, for the major part of the table, interpolation by formulas involving second central differences (tabulated alongside the entries) is adequate for the maximum attainable accuracy. Specifically, the function is tabulated at intervals of 0.0001 in the range between zero and 0.9890 and at intervals of 0.00001 in the range between 0.98900 and unity.

Air Navigation, by Erwin F. Freundlich; Oliver and Boyd Ltd., London, 1945; 112 pages, 7*s.* 6*d.*

Based on lectures delivered to British Air Ministry students at the University of St. Andrews, this book is designed to meet the requirements of pilots who desire a fuller knowledge of the principles of air navigation than is normally acquired during training. Chapters are devoted to the determination of position; the standard directions, and the compass; the analysis of flight; navigation with reference to a moving system; and the radius of action.

Simple Press Tool Practice, by R. Hutcheson; Percival Marshall & Company, Ltd., London, 1944; 108 pages, 3*s.*

This booklet has been written as a guide for those who wish to become press-tool makers. It shows the types of press tools in common use and describes the principles involved in their operation, the way some of these tools are constructed, and the methods adopted by the toolmaker in plying his trade.

Translation Key to Kleinlogel's Rahmenformeln, by F. S. Morgenroth; Frederick Ungar Publishing Company, New York, 1945; 49 pages, $1.25.

As an aid to the reader in obtaining a better understanding of the technical book *Rahmenformeln* (Formulas for Stationary Frameworks), by Adolf Kleinlogel, the author of this Key has prepared translations into English of the captions accompanying the drawings in the original book, and explanations of the symbols used in the mathematical expressions. Comments are made in English to clarify the meaning of the notations and formulas and the assumptions taken in the original text. The references are keyed to the page numbers and figure numbers in the original volume. The Translation Key is indexed and has a German-English vocabulary. Examples are given to assist in the use of the Key.

Praktische Functionenlehre, Erster Band: Elementare und elementare transzendente Funktionen (Unterstuffe) (Practical Function Theory, Vol. I: Elementary and Elementary Transcendental Functions of the Lower Order), by Friedrich Toelke; Springer-Verlag, Berlin, 1943; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1945; 261 pages, $6.50.

Tables of functions are given which are stated to be as accurate as human ability can make them. They are intended to be helpful to technical men by relieving them of the labor of repeated mathematical computations. The tables give solutions of integrals, differential equations, and integral equations that are encountered repeatedly in engineering calculations, so that the engineer can concentrate on his design problems and be free of the wearisome details of solving routine equations.

The first volume deals with the lower order of elementary and elementary transcendental functions. Other volumes planned by the author include (Vol. II) The higher order of those functions; (Vol. III) Theta Functions; (Vol. IV) Elliptical Functions; (Vol. V) Hypergeometrical Functions and Spherical Functions; and (Vol. VI) Cylindrical Functions. Only the first volume has been published at the present time.

Einfuehrung in die Statik (Introduction to Statics), by Fritz Chmelka and Ernst Melan; Springer-Verlag,

Vienna, 1943; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1945; 132 pages, $3.25.

Based on lectures given by the authors at the Department of Architecture of the Vienna Technical Institute, this book deals with the fundamentals of statics, as a basis for further studies. Although most of the examples refer to technical applications, the authors do not attempt to give a complete representation of the practical statics of architecture.

Handbook of Nonferrous Metallurgy, Editor-in-Chief Donald M. Liddell; McGraw-Hill Book Company, Inc., New York, 1945; 721 pages, $7.00.

This second part of a revised two-volume handbook for students of metallurgy, engineers, and metallurgists, is devoted to the recovery of metals. Each metal is dealt with in detail. Information is provided about sources, production, uses, markets; chemical, physical, and mechanical properties; melting and casting, mechanical treatment, drying, etc.

Elementary Engineering Electronics, by Andrew W. Kramer; The Instruments Publishing Company, Inc., Pittsburgh, 1945; 340 pages, $2.00.

In this book the fundamental principles of electron tubes and their application in industry, particularly in the field of instrumentation, are explained without the use of anything beyond elementary mathematics. The book is offered to supply the need for a text that is not too advanced yet not so elementary as to fail as a practical guide. Step-by-step explanations are given of how electron tubes work and how they can be made to serve useful purposes. The text has special reference to electronic methods of measurement and control.

Electronic Equipment and Accessories, by R. C. Walker; Chemical Publishing Company, Inc., Brooklyn, N.Y., 1945; 393 pages, $6.00.

The author's object is to provide a simple introduction to the main sections of the subject of electronics. The volume is intended to aid practical engineers, mechanics, students and other readers who are familiar with the elements of electricity and magnetism, but who are not specialists in the use and design of electronic apparatus. Emphasis is placed on principles and on illustrative examples of applications outside the field of telecommunication. The latter part of the book is devoted to accessory equipment associated with the electronic control of small mechanisms.

Fiction and Juvenile Books

Whisper Flight, by Lt. Col. John B. Stanley; Dodd, Mead & Company, New York, 1945; 210 pages, $2.00.

Fiction like this based on actuality is sometimes more interesting than an autobiographic story that emphasizes facts that appeal only to the writer. This tale of a Lieutenant of the American Airborne Engineers takes him on a special mission connected with the aerial invasion of Burma by the Allies.

Attacks by enemy fighters, an escape by parachute, evacuation by Cub planes and finally participation in the glider-borne landing behind the Japanese lines make the story one of the thrilling accounts of that unique aerial operation in the Far East.

Nick and Nan in Yucatan, by Alan Crane; Thomas Nelson & Sons, New York, 1945; 29 pages, $2.00.

While this illustrated book for young children is concerned primarily with the introduction of two American children to the wonders of a foreign country, it begins with an account of how the children traveled by airplane to Yucatan and their reactions to the things they observed while in the plane.

Coconut Crackers, by E. Tabuteau; Oswald-Sealy Ltd, Auckland, N.Z., 1944; 19 pages, 2*s*.

A series of 20 cartoons records the life of Royal New Zealand Air Force personnel in the Pacific war. Incidents depicted pertain to the Air Force personnel's living conditions and pastimes during leisure hours rather than to the men's combat experiences.

The Children's How and Why Aeroplane Book, edited by Morley Adams; Faber and Faber Limited, London, 1944; 48 pages, $1.00.

A book for children of primary-school age, explaining in simple language the fundamentals of airplane design, construction and operation. It is plentifully illustrated by line drawings.

Wake of Glory, by Jack Redding and Thor Smith; The Bobbs-Merrill Company, New York, 1945; 268 pages, $2.50.

Two American Army Air Forces' officers fall in love with an English girl. One disappears while in flight over Germany and his successor takes his place in the affections of the girl. Later, the first returns and typical wartime complications ensue.

The life at an airfield in England is depicted in vivid style and the whole book reveals the activities of our airmen during the critical period of the war.

Dave Dawson with the Eighth Air Force, by R. Sidney Bowen; Crown Publishers, New York, 1944; 252 pages, $0.60.

One of the War Adventure Series written for boys, this book deals with the hero's experiences as a fighter pilot in England.

Airline Girl, by Patricia O'Malley; Dodd, Mead & Company, New York, 1944; 202 pages, $2.00.

One who has had long experience in public relations work writes a novel describing the experiences and romance of a girl who starts her career in the information department of Transcontinental & Western Air, Inc. In addition to being a good story, the book is a primer describing the various activities at an airport.

Library Accessions

"Flight Strips" Their Development from 1935 to 1942, A Selective Annotated Bibliography; Army Air Forces Library, Washington, D.C., 1942; 15 pages.

Vibration in Electrical Conductors, Including Allied Researches; Hydro-Electric Power Commission of Ontario, Toronto, 1936; various paging.

Generalization of Aerodynamic and Electrodynamic Fundamental Equations, by N. P. Kasterin; Academy of Sciences of the U.S.S.R., Moscow, 1937; 16 pages, $0.15.

Manual de Aviacion, by Alfredo de San Juan; Editorial Atlante, S.A., México, D.F., 1941; 245 pages.

Navegacion Aerea, by Enrique Pascual del Roncal; Editorial Atlante, S.A., México, D.F., 1941; 272 pages.

Newfoundland, by R. H. Tait; published by R. H. Tait, Newfoundland Information Bureau, New York, 1939; 260 pages, $1.50.

Bombers' Moon, by Negley Farson; Victor Gollancz, Ltd., London, 1941; 160 pages, 8*s*. 6*d*.

Aviation Medicine, by Ernst Jokl; Unie-Volkspers Beperk, Cape Town, South Africa, 1942; 213 pages, 10*s*. 6*d*.

The Defence of Towns, by Col. G. A. Wade; Gale & Polden Ltd., Aldershot, England, 1942; 36 pages, 1*s*. 6*d*.

While London Burns, by F. Tennyson Jesse and H. M. Harwood; Constable and Company Ltd., London, 1942; 380 pages, 12*s*.

Sam Small Flies Again, by Eric Knight; Grosset and Dunlap, New York, 1942; 285 pages, $1.00.

The Northern Garrisons, by Eric Linklater; Garden City Publishing Company, Inc., Garden City, N.Y., 1941; 71 pages, $0.50.

BRANIFF AIRWAYS–

Oklahoma Acorn to International Oak

Braniff Airways operations building at Love Field, Dallas, Texas.

People who talk about the pioneer days being over and the lack of new fields for conquest don't know Tom Braniff and the Braniff legend.

For one of the characteristics of Braniff Airways has been that it has always kept its eyes on the ever expanding horizons of aviation.

Starting with one plane, three employees, and a 116 mile route from Oklahoma City to Tulsa, Braniff has become one of the leading air carriers of the country—3,749 miles of domestic routes, flying 28,000 miles daily, and with over 1,500 employees.

And now, the erstwhile little Oklahoma airline points toward becoming an important factor in International aviation!

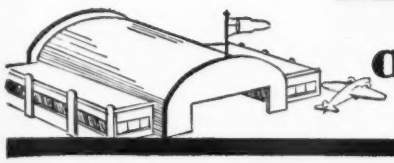
People like Braniff *must* be on their toes. That's why we think it is significant that their planes use Phillips Aviation Gasoline.

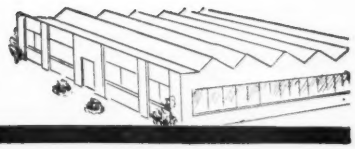
We firmly believe that the best indication of the quality of a product is the kind of people who use it. Nuff said! Aviation Department, Phillips Petroleum Company, Bartlesville, Oklahoma.

T. E. Braniff, President of Braniff Airways, and one of the great pioneers of domestic airline operation.

Phillips
AVIATION GASOLINE

House Organs and Catalogues





Application of Enemy Innovations to American Aviation

What Can We Learn from German Air Might? German and Italian contributions to the science of flight and the effect of these developments upon present and future American planes are investigated. The discussion of the relationship between enemy research and development knowledge and specific applications of it to Allied designs takes into account perfection of the jet-powered plane, rocket propulsion, progress in solving problems of near-sonic speed, problems of torque, and refinement of flying-wing aircraft. The importance of planned research as one lesson learned from the enemy is stressed, and a description of the German Experimental Institute for Aeronautics and the Italian establishment at Guidonia which helped to make possible German and Italian achievements in aeronautical progress is included. *The Pegasus*, December, 1945.

History of an Aircraft Manufacturer

The Stinson Story of Aircraft Progress is the title of a 48-page booklet that traces the history of the Stinson Division of Consolidated Vultee Aircraft Corporation and its predecessors, with emphasis on the career of Edward A. Stinson. Episodes in his life are included, and information is given about the company he established and the progress it has made. *Stinson Division of Consolidated Vultee Aircraft Corporation.*

Pages for Manual of Aircraft Materials

Revised Pages for Manual of Aircraft Materials. Four corrected pages have been issued for insertion into the *Manual of Aircraft Materials*. The revised pages are 86, 244, 245, and 246. They contain tables of sizes and weights of steel strip and wire. *American Steel & Wire Company*, Cleveland.

Heat-Measuring Instruments

Wheelco Thermocouple Data Book and Catalog. Containing 32 pages and designated *Bulletin S2-6*, this new edition includes information about the selection and installation of thermocouples. It describes and offers recommendations on thermocouples, thermocouple wire, lead wire, heads, connectors, plug and socket assemblies, insulators, and protecting tubes. *Wheelco Instruments Company*, Chicago.

Hydraulic Machines

Barnes L Type Self-Contained Hydraulic Units. The construction, operation, and advantages of a line of L-type hydraulic units are described in *Bulletin 302-U*. Dimensions, specifications, and illustrations supplement the descriptive data, while three schematic drawings illustrate the operating principles of the unit. *John S. Barnes Corporation*, Rockford, Ill.

Machinery and Facilities for Fabricating Production Parts

Ex-Cell-O Production Parts. An illustrated folder describes the facilities for manufacturing production parts and unit assemblies offered by a producer of machine tools and cutting tools. It is claimed that this manufacturer is equipped to handle parts from rough stock to finished pieces. Engineering, machining, heat-treating, grinding, subassembling, and inspection are all performed under one management. *Ex-Cell-O Corporation*, Detroit.

Airport Facilities and Ground-Handling Equipment

Hangars and Docks for Douglas Transports. Ideas in hangar design, innovations in fixed work docks for aircraft, and trends in ground-handling equipment are illustrated in this pamphlet. Supplemented by specifications, cost estimates, and floor plans, the drawings show a proposed hangar for large transport aircraft, a semishelter, service docks, hydraulic engine lifts, and a free-weight jacking system. *Douglas Aircraft Company, Inc.*

Explanation of Wire Strain Gages

The Determination of Strain by the Resistance Wire Gauge. Part I. E. C. J. Gray. Marking the resumption of publication after an interval since May, 1942, the house organ of Miles Aircraft, Ltd., England, begins a serial article about the measurement of strain by means of resistance-wire gages. It contains an explanation of the elementary principles upon which the wire strain gage operates and describes the apparatus and the methods used, as well as the instruments employed to measure the indications obtained by the strain gage.

Comparisons are made between the methods followed in England and those employed in the United States. *Miles Magazine*, October, 1945.

Chart for Applying Aluminum Bronze Electrodes

Ampco-Trode Industrial Application Chart. Bulletin W-8 lists industries in which Ampco-Trode coated aluminum bronze electrodes have been used, types of proved applications in these fields, and recommended grade of bronze weldrod for each. Recourse to this bulletin gives the reader information regarding the recommended grade of welding electrode to be used in an application in some particular field, including aviation, and also gives guidance in the selection of rod for a diversified range of applications. *Ampco Metal, Inc.*, Milwaukee.

Electrical Apparatus for Airplanes

Alternating Current Electrical Systems for Large Aircraft. The application of alternating-current systems to large airplanes is outlined in this loose-leaf book. Each chapter is a signed contribution of a Westinghouse engineer, and all attempt to treat the subject from a broad point of view. Following a review of the history of alternating-current electric power for aircraft and a description of modern systems, there is a discussion of alternators. Subsequent chapters deal with alternator-driving mechanisms, voltage regulation, parallel operation, distribution systems, circuit breakers, relays, power for direct-current auxiliaries, motors, and instruments for the electrical system. Additional information regarding alternating-current voltage and power is contained in the appendix. *Westinghouse Electric Corporation.*

Standard Specification for Drawing Boards and Tee Squares

The British Standards Institution has issued a publication containing the first four of a series of specifications relating to drawing-office equipment and materials. These specifications have been prepared in collaboration with the Drawing Office Material Manufacturers' and Dealers' Association.

The individual standards bear the following titles: *B.S.1265, Engineers' Pattern Drawing Boards; B.S.1266 Engineers' Pattern Ebony Edged Tee Squares; B.S.1267, Students' Clamped Drawing Boards; B.S.1268, Students' Tee Squares.*

Each of these specifications comprises nominal sizes and names, a general description, materials, workmanship and constructional details, finish, and limits

Joins the swing to

HAYES
AIRCRAFT
Wheels and Brakes

THESE KNOW TOO

CONTINENTAL AIR LINES

EASTERN Air Lines

PCA THE CAPITAL AIRLINE

UNITED AIR LINES

WESTERN AIR LINES

by PROOF on the runways

OPERATIONAL tests under the wide variation of flying and landing conditions met in a system covering the geographical area served by Braniff Airways and Aerovias Braniff deliver the results leading to adoption of Hayes Wheels and Hayes Heavy-duty Expander Tube Brakes.

WHAT are the results delivered in the engineering, manufacture and use of Hayes Industries products? . . . Reduced Overhauls . . . Overhaul Charges Cut . . . Parts Replacement Costs Cut . . . summed up in LOWER COSTS PER LANDING than ever before.

Western Representative: Airsupply Co., 5959 W. 3rd St., Los Angeles 36, Cal.

HAYES INDUSTRIES, INC. Home Office: JACKSON, MICHIGAN, U. S. A.

of sizes. Illustrations of two types of drawing boards are included. *British Standards Institution*, London, 2*s*. each.

Wall Chart About Alloy Welding

Reference Chart on Alloy Welding. A wall chart measuring 20 by 30 in. gives data about high- and low-alloy welding electrodes. It contains tables on corrosion resistance, heat resistance, and weld-metal surfacing, as well as data about the chemistry of the weld metal. Welding current and voltage tables give information for the guidance of the operator. *Arcos Corporation*, Philadelphia.

Machine-Shop Terminology

Glossary of Machine Shop Terms. A glossary of the terms used with reference to machine-shop work defines and explains the terminology used in heavy machine-shop practice. Included in the definitions and explanations are terms and expressions commonly utilized in connection with the machine-shop work involved in the manufacture and maintenance of aircraft. *Kropp Forge Company*, Chicago.

Prefabricated Airport Structures

Stran-Steel Airport Buildings. How the wartime "Quonset" hut as originated and manufactured for the Army and Navy can be adapted to the construction of airport buildings is explained in a 6-page leaflet. Drawings show the construction of T-hangars, equipped with sliding doors, for private or municipal airports, having flat roofs instead of the original round roof of the Quonset hut. Another form of building retains the round-roof construction, this type being offered to provide office and waiting room facilities and maintenance buildings for airports. Wall and roof material is fastened in place by nails driven into the patented nailing groove, a characteristic of the Quonset type of construction. *Great Lakes Steel Corporation, Stran-Steel Division*, Detroit.

Metal-Spraying Equipment

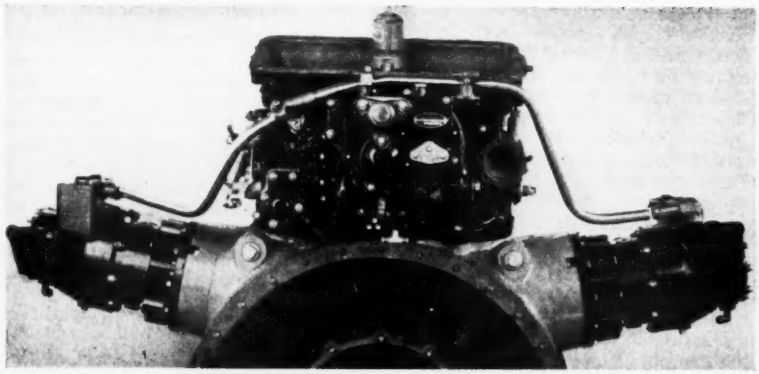
The Metco Type Y Metallizing Gun is described and illustrated in a catalog of 12 pages. Details are given about the design and interior construction of the spray gun and its accessories, used for repairing metal work by a spray process known as "metallizing." *Metallizing Engineering Company, Inc.*, New York.

Commercial-Aircraft Catalog

The Airspeed Ambassador transport airplane is described and illustrated in a 6-page catalog. Specifications of the airplane are given, together with photographs and drawings showing the interior layout and dimensions. *Airspeed, Ltd.*, Portsmouth, Hants, England.

Stainless Steels for Aircraft

Republic Enduro Stainless and Heat-Resisting Steels is the title of an illustrated catalog in which the uses of stainless steel in aircraft construction are featured. One section tells about the part played by stainless steels in the manufacture of aircraft armament; another deals with the use of stainless steels in the air frame, for structural assemblies, and for fire protection. Other sections illustrate stainless-steel aircraft accessories, superchargers, and exhaust systems. In addition to the aircraft applications mentioned, the booklet shows applications of stainless and heat-resisting steels in other industries. *Republic Steel Corporation*, Cleveland.



Bendix-Stromberg direct-injection fuel system. The air-metering unit containing the air throttles and fuel-regulating devices is mounted in the center, and the injection pumps are connected to it by stainless-steel tubes.

Report on Electrical Aircraft Systems

Electrical Power Systems for Aircraft is a report, prepared for the Air Transport Association, giving the results of a study made over a period of 6 months, during which the writer toured the country and interviewed large numbers of individuals and concerns engaged in the many branches of the aeronautical industry. The purpose of the study was to contribute to an effort to formulate specifications for the aircraft of the future, this report forming a part of the activity intended to develop information concerning the most suitable types of electrical power equipment.

The first section explains the uses and sources of power in an airplane and gives the advantages of the various systems and the types of aircraft for which the systems are suitable. The second section contains recommendations regarding the type of electrical equipment to be installed and the operation of such equipment, and the third section consolidates various miscellaneous comments concerning the preparation of the report. The fourth section is a brief summary of the entire report. An appendix contains a tabulation of the functions in an airplane which are accomplished by means of electric power. *Aeronautical Radio, Inc.*, Washington, D.C.

Aircraft-Landing Control Equipment

Radar Landing Control by Gilfillan defines and explains the functions of a system that utilizes radar to facilitate the ground direction of airplane landings at an airport under unfavorable weather conditions. The booklet gives a nontechnical explanation of the operation of radar control and cites examples of the operation of the system by the military services during the war. The system is now stated to be available for commercial air lines. *Gilfillan Brothers, Inc.*, Los Angeles.

Conveyer System

Spot Conveying. An 8-page illustrated bulletin contains information about the Power-Flex unit conveying system, together with complete specifications and data. The "spot conveying" principle upon which the system is based is also explained. *Island Equipment Corporation*, New York.

Compact Electrical Instrument

Fairchild Non-Linear Potentiometers is the title of a 4-page folder containing a general description of a group of small-size instruments offered for numerous general applications in the simplification of electric control circuits. A brief description of the instrument is given, together with suggested uses in which it can be employed. It contains reproductions of records made by the potentiometers in four different applications and a list of condensed specifications. *Fairchild Camera & Instrument Corporation.*

Aircraft-Tire Retreading

Thompson Aircraft Treads is an illustrated booklet outlining the methods followed in retreading aircraft tires so that they comply with Government specifications. The various steps in the process are described and illustrated. *Thompson Aircraft Tire Corporation*, Los Angeles.

Aero Research Technical Notes

Aerolite and Redux in the Air. Information, heretofore restricted, with regard to certain applications of Aerolite and Redux glues to wartime aircraft construction is now released. The bulletin also tells about the use of these

products in the construction of the Vickers Viking, described in the bulletin as the first British commercial air liner employing synthetic Aerolite glues for stressed areas. Uses of these glues by the Royal Air Force are also given. *Bulletin No. 35, The Director of Research and Development, Aero Research Limited,* Duxford, Cambridge, England.

Electronic Gages

"Gnat's Eyebrow" Gaging. A survey of the precision gages used by Jack & Heintz, Inc., for the manufacture of aircraft bearings. The principle of electronic displacement pickup upon which the gages are based is explained briefly, and details are given about several of the instruments. Among the gages noted are the following: outer-race groove gage; inner-race groove gage; radial freedom gage; concentricity and groove-parallel gage; electronic ball separator; ring gage comparator; electronic comparator; and height gage. *Jahco News,* September-October, 1945.

Aluminum-Bronze Alloys for Dies

Ampco Metal in Dies. Bulletin 58 illustrates and describes the uses of aluminum-bronze alloys in forming and drawing dies. It outlines the factors necessary for good results obtained by the use of satisfactory forming and drawing die metal and explains the features of this particular metal. *Ampco Metal, Inc.,* Milwaukee.

Machine Tool Accessories

Sutton Collets. In addition to illustrations and descriptions of standard draw-in and push-out collets, a recent 6-page folder lists a new type of full-floating collet with interchangeable and replaceable jaws developed especially for handling hot-rolled stock. The folder also features the diamond-serrated principle used in the gripping fingers of the collets, a design that is stated by the manufacturer to offer better gripping action, reduced spoilage, and easier handling of the work. *Sutton Tool Company,* Sturgis, Mich.

Maintenance Booklet

Air Liner Maintenance contains a group of pictures, with numbered explanatory captions, illustrating suggested methods to be followed in airplane-maintenance work with a view toward the greatest possible safety. It explains numerous maintenance routines that have been demonstrated by experience to produce satisfactory results. *Gulf Oil Corporation.*

A.C. Arc Welding Machines

"Bumblebee" Alternating Current Arc Welding Machines. New and improved "Bumblebee" alternating-current transformer arc welding machines are described in a 16-page illustrated booklet. Among the machines noted are the 300- and 500-amp. standard and all-weather models and a new 200-amp. machine designed to meet the demands for a small, efficient arc welder.

Additional sections are devoted to small transformer-type alternating-current welders, running gear, remote control, and a line of shielded-arc electrodes for a.c. welding. Engineering data and specifications are supplied. Drawings and numerous photographs supplement the text. *Air Reduction Sales Company, Inc.,* New York.

Air-Transport Statistics

Air Transportation: Yesterday, Today, Tomorrow. Statistics regarding the growth of air transportation and the war record of the commercial air lines of the United States are compiled in a 12-page booklet. Estimates are made of the great expansion that is anticipated for commercial air transportation in the postwar period. *Air Transport Association of America.*

Metal-Powder Friction Materials

Gempco Powdered Metallic Friction Materials. Brief specifications are given for the use of compressed metal-powder friction materials for various types of clutch facings, brake linings, and similar devices. Comments are made about the suitability of the material for the applications suggested, and an explanation is given of how the material performs the functions for which it is intended. *The General Metals Powder Company,* Akron, Ohio.

Uses of Plywoods

Flat or Molded Waterproof Weldwood. Numerous industrial applications for molded and flat plywood materials are outlined in an illustrated booklet. The processes by which the material is prepared are described. In addition to various industrial applications, particular attention is paid to aircraft parts manufactured of molded Weldwood. The process of manufacturing the material is explained in another booklet that traces the production of these plywoods from the original timber to the finished product. *United States Plywood Corporation,* New York.

Aircraft Insurance

The Seven Types of Aviation Insurance are outlined in a file-sized foldet containing brief information abour policy coverages, rates and schedules, specimen policies, application forms, and other data concerning aircraft insurance. *Associated Aviation Underwriters,* New York.

Data About Plastic Adhesives

Manual of Technical Data: Pliobond Plastic Adhesive. A loose-leaf manual contains general descriptions of a thermoplastic adhesive, its properties, and the applications for which it is suitable. Instructions are given for the preparation of the surface for bonding and for other steps necessary in the process. Numbered data sheets set forth de-

ENGINEERS

Work in California!

NORTH AMERICAN AVIATION

Is designing aircraft of the future and needs experienced:

ENGINEERING DESIGNERS & DRAFTSMEN

AERODYNAMICISTS

STRESS ANALYSTS

Biggest research and development projects in company's history offer good pay, fascinating work and opportunity for the future.

Write E. R. Carter
Engineering Dept.
5601 Imperial Highway
Inglewood, Calif.

NORTH AMERICAN AVIATION, INC.

Sets the Pace

Aircraft Engineering

FOUNDED 1929

The Technical and Scientific Aeronautical Monthly

Edited by
Lt.-Col. W. Lockwood Marsh
F.I.Ae.S., M.S.A.E., F.R.Ae.S.

Single Copies: 50 cents post free
Subscription: $5.25 per annum, post free

During the War, a special feature is being made of reproductions and translations from the Foreign Technical Press

BUNHILL PUBLICATIONS LIMITED

12 Bloomsbury Square
London : : W.C.1.
England

tailed instructions for the various methods of bonding with this material, together with specifications for the different types in which the material is commonly available. *United States Plywood Corporation.*

Safety Tools

Safety Tools of Ampco Metal is a data sheet, *Bulletin 76*, giving specifications and other information about a group of safety tools made of Monel metal, intended to eliminate fire hazards rising from the use of tools in the presence of explosive gases, fumes, or dust. The bulletin gives the chemical composition and properties of these Monel-metal tools, suggested applications, and other details.

Fire Insurance in Tools is a 4-page bulletin offering additional information concerning hand tools designed to eliminate danger rising from the striking of sparks in the presence of inflammable materials. *Ampco Metal, Inc.*, Milwaukee.

Coolant Filter

Cuno Coolant-Klean Filter. A new filter is designed to remove abrasive and metallic particles from grinder coolant. It is said to be a compact, replaceable-element type, applicable to unit machines or centralized systems. Advantages are cited for the device, such as simple, positive action for producing fine finishes, fewer replacements of the filter element, and less loading of the grinding wheel.

Average cost of operation is reported to be a few cents a week. Installation is accomplished in about 15 min., because no alteration of the grinder is required and in most cases only two hose connections are needed.

The cloth-type filter element is replaced in less than 5 min. Users have reported effective service periods up to 6 weeks without replacement. The filter may be applied to any type of grinder and is adjustable to almost any machine using a coolant or cutting oil. *Cuno Corporation*, Meriden, Conn.

Personnel Opportunities

(*Continued from page 48*)

References based upon accomplishments. Desires affiliation in responsible capacity with progressive engineering organization. Address inquiries to Box 354, Institute of the Aeronautical Sciences.

Industrial Engineer—B.S.M.E. Eleven years' experience in selecting equipment and supervising installations for aircraft manufacturing processes, including experience in production of airplane motors; also twenty-five years' experience in the automotive engineering and production field. In a position to do consulting work as industrial engineer. Address inquiries to Box 353, Institute of the Aeronautical Sciences.

Engineer—B.S. in M.E. Age 27, married, two dependents. Seven years' varied aircraft engine experience. Past positions include Test Engineer, Supervisor of Carburetor Test Laboratory, and Assistant Chief Inspector. Desires engineering position doing experimental research or product development. East Coast preferred. No objection to traveling. Address inquiries to Box 350, Institute of the Aeronautical Sciences.

Development Engineer, A.E. graduate. Experience includes complete development and sales engineering of aeronautical and mechanical accessories and instruments. Background of light plane and military aircraft design. Private pilot. West Coast location preferred. Address inquiries to Box 349, Institute of the Aeronautical Sciences.

Tool and Gage Foreman—Past 5 years in designing, planning, and supervising gage manufacture. Experience covers other types of precision tools such as broaches, dies, etc. Previous experience in tool and die work outside of aircraft industry. Thoroughly versed in Tool Steel Heat Treating, Nitrioning Process, Stabilizing, Immersion type and Open Hearth Furnaces. Connected with large aircraft manufacturing plant. Seeking position as Foreman or Assistant Foreman with reliable firm, not necessarily aircraft. Willing to locate anywhere in United States and Possessions. Address inquiries to Box 346, Institute of the Aeronautical Sciences.

Registered Professional Aeronautical Engineer—Has successful consulting practice; would like to represent a responsible aviation corporation or air-line company in the Detroit and lower Michigan area. Graduate degrees from two universities; 8 years' experience as consultant, engineer, executive and professional man. Services could cover all fields such as engineering and sales contacts, technical and professional representative, etc. Permanent appointment with modest monthly retainer fee desired. Address inquiries to Box 345, Institute of the Aeronautical Sciences.

Senior Aerodynamicist—Over 20 years' experience in aeronautics. Excellent theoretical background. Now Research Engineer with big company. Desires permanent responsible position, preferably as Consulting or Research Engineer. Address inquiries to Box 344, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S.M.E., University of Colorado; M.S. Aero. Eng., Massachusetts Institute of Technology. Five years' experience: 4 years with A.T.S.C., Engineering Division, Wright Field in Flutter, Aircraft Dynamic Load Measurement, and general development of mechanical and electronic instruments and recording equipment. Desires position in instrument research and development and flight test engineering. Address inquiries to Box 342, Institute of the Aeronautical Sciences.

Helicopter Chief of Structures—Two years' Chief of Structures, Sikorsky Aircraft, formerly Chief Stress Analyst other leading rotowing manufacturer. Licensed professional engineer, New York, New Jersey, Connecticut, Pennsylvania. Twenty years' structural designing background. Address inquiries to Box 341, Institute of the Aeronautical Sciences.

Engineer—B.Ae.E.; M.S. in M.E.; Ph.D.; Aeronautics major. Holds pilot's license and C.A.A. ratings to teach all phases of ground school. Prefers position in industry but will consider a university position with research and consulting possibilities. Location on west coast preferred but not a limitation. Address inquiries to Box 336, Institute of the Aeronautical Sciences.

Graduate Aeronautical Engineer—Bachelor and Master of Aeronautical Engineering degrees from N.Y.U. Two and one-half years' engineering in aircraft manufacturing and 2½ years' engineering in air-line maintenance and operation. Recently completed engineering and economic studies on major postwar aircraft for air-line operation. Will receive Masters in Commerce and Finance in 2 years. Draft exempt and release available. Excellent references. Address inquiries to Box 332, Institute of the Aeronautical Sciences.

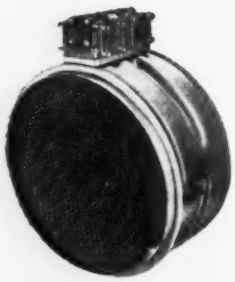
Aeronautical Engineer—Pilot—Graduate engineer over 15 years' experience in design, research, and manufacturing; eight years as experimental test pilot; eighteen years' flying experience. Past employment includes several years as consulting engineer and chief engineer with large company. No objection to traveling. Address inquiries to Box 307, Institute of the Aeronautical Sciences.

Production Executive—Mechanical engineer with five years' administrative experience in all phases of aircraft construction including line assembly methods, tool and jig design, and one year as Director of Experimental. Served ten years as Works Manager of large plant fabricating precision metal parts for automatic actuating mechanisms. Thoroughly familiar with modern precision machine shop practice, serving eight years as Plant Manager. Manufacturing experience totals 26 years. Automotive background. Enjoys a wide acquaintance among subcontractors in central and eastern area. Will travel. Address inquiries to Box 292, Institute of the Aeronautical Sciences.

AiResearch Oil Cooling Systems

ON LEADING AIRPLANES

DOUGLAS SKYMASTER
13" Aluminum Oil Cooler.
Weight 39½ lbs.



BOEING STRATOCRUISER
16" Aluminum Oil Cooler.
Weight 35 lbs.

LOCKHEED CONSTELLATION
Aluminum Elliptical Oil Cooler (220 sq. in. cooling area). Weight 35 lbs.

AiResearch leadership in the aircraft oil cooling field was well established before the advent of war. So much so, that by war's end *more than half the total aircraft tonnage produced for the Army Air Forces had been equipped with AiResearch oil cooling systems.*

AiResearch was *first* to produce the thermostatically controlled oil cooler shutter, *first* to perfect the elliptical oil cooler, *first* with surge protection, *first* with electric flap control, *first* to fulfill government specifications with coolers over 16 inches in diameter and *first* to build a standard Army-Navy four port valve.

Today, AiResearch is building oil cooling systems for the mighty luxury transports of Lockheed, Douglas, Boeing and Consolidated, as well as for numerous small craft. This background of specialized research and skill in precision manufacturing is available for working out your problems. AiResearch Manufacturing Company, Los Angeles, California.

"Where Controlled Air Does the Job" Automatic Exit Flap Control Systems • Temperature Control Systems • Engine Air Intercooling Systems • Cabin Pressure Regulating Systems • Engine Oil Cooling Systems • Supercharger Aftercooling Systems

AiResearch
DIVISION OF
THE GARRETT CORPORATION

From the Industry

Ultra-Sensitive Diaphragm Pressure Switch

Originally designed to control automatically the intercooler flap on fighter planes, a sensitive diaphragm pressure switch is now available for other applications. Specifications show a sensitivity of 0.01 in. of water on stationary applications. The instrument may be adjusted to any pressure value desired by means of two knobs. For accurately determining these pressures, a draft gage may be connected in parallel with the pressure switch. Aerotec Company, White Plains, N.Y.

Ducting Material

"Airtron," a new material created during the war for aircraft heating and ventilating, is available as a ducting material for hot or cold air. Made of glass cloth and rubber, it provides high insulation qualities as well as flexibility, for use where vibration is present.

It is reported to withstand temperatures from −60°F. to +300°F. without a change in properties, and will stand well over 50 lbs. per sq.in. internal pressure at all temperatures. It is unaffected by air, light, water, gasoline, oil, and all but concentrated mineral acids. Manufactured in tubes from 1 in. to 6 in. in diameter and in any length desired, as well as in specialized shapes where required for unusual installations, the ducting can be adapted to any equipment as a replacement or as an original installation. Arrowhead Rubber Company, Los Angeles.

The XA-38 Tactical Airplane

Details are now reported of an advanced tactical airplane that Beech Aircraft Corporation designed and built during the war. Popularly termed the "Grizzly," the plane was officially known as the XA-38. This heretofore secret aircraft is said to combine the size of a medium bomber with the speed of the faster propeller-driven fighters, the speed being obtained by a "clean" aerodynamic design.

The XA-38 is designed to carry a 75-mm. automatic cannon which is mounted in the nose. Manned by a pilot and gunner, the plane also mounts six 0.50-cal. machine guns in addition to the cannon. It was designed as an attack plane, with a primary mission of destruction of tanks, armored vehicles, light surface vessels, ground installations, and attack on submarines by gunfire. A secondary tactical mission of bombing and smoke-screen laying may be performed by externally mounting bombs, depth charges, and chemical tanks.

The empty weight of this twin-engined, all-metal midwing monoplane is 23,230 lbs., and the design gross weight is 29,900 lbs. However, various combinations of fuel, oil, external bombs, external long-range fuel tanks, and smoke tanks may be carried at gross weights up to a maximum alternate gross weight of 36,332 lbs. Length of the plane is 51.7 ft. and the wing span is 67.08 ft. Outside maximum width of the fuselage is 56 in. and the maximum fuselage height is 92 in.

Despite high speeds, the XA-38 at a gross weight of 31,250 lbs. will land at low speed in a small area. It is also said to have exceptional single-engine characteristics.

The forward part of the fuselage has a steep slope giving the pilot a good view downward and forward. The pilot's seat is adjustable vertically and will accommodate a seat-type parachute. Access to the pilot's compartment is through a hinged section of the cockpit enclosure, reached from the upper surface of the wing.

Cooling is controlled by automatic flaps operated by a General Electric cooling unit having a temperature element in the hottest engine cylinder. A stop is provided so that the cowl flaps will not close beyond the high-speed flight position. A manually controlled system is provided as auxiliary equipment for opening and closing the cowl flaps.

Propellers are Hamilton Standard, three-bladed, constant speed, full feathering, with a minimum blade angle of 16° and a maximum blade angle of 82° as measured at the 72-in. radius.

The wing airfoil section is derived from NACA-2300 series, 18.87 per cent thick at the root chord and 12 per cent at the tip chord.

The leading edges of the wings are heated by internal ducts and the entire surfaces of the wings are warmed by air discharging from the leading-edge ducts and passing through the wing to the trailing edges. Wing tips and outer panels are removable to facilitate fabrication and replacement. The center section is built in halves, joined together at the fuselage centerline. Slotted-type flaps extend over the span of the center section on each side, except for the portion enclosed in the fuselage. Ailerons extend from the outer panel joint to the removable tip.

Control surfaces are of the conventional type. The ailerons, elevators, and rudders are aerodynamically, dynamically, and statically balanced. Aileron area is 51.7 sq.ft., or 8.2 per cent of the wing area.

The dual vertical tail is similar in design to other twin-engined Beechcrafts. Fins have an area of 33 sq.ft., with a normal setting straight forward and no angular movement. The rudders have an area of 36.8 sq.ft., with an angular movement of 25° both to the right and left. The fin is a two-spar skin and stringer construction. The rudders are constructed with a formed aluminum-alloy frame, metal covered over the nose section. The chord of this balance area is increased somewhat near the top to provide additional balance area.

Fuselage construction employs bulkhead rings and longitudinal stringers. Flush rivets and skin joints are used on external exposed surfaces to minimize aerodynamic drag. The fuselage is made in four main sections to permit maximum manufacturing facility and easy replaceability.

The alighting gear consists of two main wheels and a full-swiveling tail wheel that can be locked in the forward position. Both main wheels and tail wheel retract and extend by hydraulic means, with separate and independent hydraulic and pneumatic emergency systems. The auxiliary systems are independent of the main system up to, but not including, the actuating cylinders. Shock struts are of the oleo pneumatic type. Beech Aircraft Corporation.

Radio Control for Robot Planes and Automatic Transmission of Flight Data

New equipment has been developed to make possible remote radio control of high-speed, high-performance, operational-sized test aircraft and the simultaneous transmission of flight data to automatic recording instruments. The new method of transmitting flight data, both by television and telemetering, is of special significance in the quest for aircraft operating in the range of the speed of sound.

In tests conducted since October, 1944, a P-59 Airacomet, remotely controlled from either a flight station or a ground station, has successfully performed maneuvers normally associated with flight-research operations. Military restrictions precluded its announcement until the present time.

SINCLAIR POWER for WINGS to MEXICO

Flagship stop between San Antonio and Mexico City. Sinclair Aviation Gasoline is taken on at San Antonio.

As one of the major suppliers of fuel to Army and Navy Air Squadrons, Sinclair is proud to have introduced its aviation gasoline to commercial flying in planes of America's greatest air transportation company — American Airlines.

Sinclair Aviation Gasoline is *powering*, Sinclair Pennsylvania Motor Oil is *lubricating* American Airlines Flagships on their daily flights from San Antonio, Texas, into Mexico. Thus Sinclair-powered flight is now added to the hundreds of millions of miles of Sinclair-lubricated flight by American's Flagships.

Sinclair Aviation Gasoline will aid advancement of transportation on national and international airways.

SINCLAIR AVIATION OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL *WRITE* SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

The development permits research into phases of flight testing previously considered too dangerous for pilots to attempt. Aircraft remotely controlled by radio also promise possible adaptation to commercial and military flying.

The most influential single factor in the success of the robot plane is a new concept of autopilot, called a "rate" autopilot, which functions effectively at diving attitudes. Radio control of the robot depends upon new and previously untested radio equipment that incorporates special and secret components designed for the Air Technical Service Command, and radio equipment vital to the functioning of television and telemetering. Normal high-frequency radio for voice communication also is incorporated in the project but is not essential. The "rate" pilot is regarded as the key to the success of the robot development.

For the new type of autopilot, two rate-of-turn gyro instruments were adopted. One was so arranged that the gyro spin axis was vertical in order to provide a method for detecting change of pitch, while the second was rotated so as to place the gyro fore and aft and provide a method for indicating rate of roll. Then, both devices, the "rate" autopilot and the "displacement" autopilot, were coupled in an electrical bridge so that their functions became interchangeable. The "displacement" pilot is called upon for maneuvers involving less than $\pm 30°$ change in pitch or $\pm 45°$ change in roll, while the "rate" pilot with its tumbling-proof gyroscopes is employed for all other maneuvers. Both the flight and ground stations have a switch on a conveniently located panel which permits selection of the autopilots. At the same time either or both autopilots can be controlled from both stations.

A miniature stick, similar in operation to the stick in a normal plane, is mounted on the regular stick in the "mother" airplane and another miniature stick is mounted on the ground operator's chair, which is secured to a platform built on top of a motor truck. To further ensure successful operation of the robot, the ground operator's controls are duplicated in the interior of the truck, so that the robot can be controlled by observation of its televised flight instruments when out of sight of either the flight station operator or the ground operator. The motions of the miniature stick closely parallel those of a normal stick.

Such parts of the robot as throttle, flaps, landing gear, brakes, etc., are actuated by servo motors that derive electrical power from circuits controlled by the radio receiver. Thus, by proper coordination of these controls, ground or flight station operators can direct the robot through warmup, taxiing, take-off, climb, level flight, banks or turns, dives, loops, and all the other maneuvers involved in flight testing of aircraft.

Flight research measurements, such as vibrations, accelerations, structural loads and strains, and other stresses not visible to the eye, are transmitted to the ground station by the telemetering process. This process functions basically as follows: the data desired, i.e., structural deformation, control position, acceleration, etc., are measured electrically by resistance elements. This information is fed in sequence to the transmitter at the rate of 1,100 complete cycles per sec. and transmitted to the ground station, where receiving equipment "unscrambles" the combined signals and feeds them appropriately into separate receiver channels for recording or observation, or both, in a multichannel oscillograph.

Television serves a dual role. One of its units televises an instrument panel in the robot plane, thereby permitting the ground operator to observe the functioning of the robot's instruments. A second unit, installed in the cabin of the robot, televises the horizon as normally seen by the pilot, relaying a vision of the horizon to the ground operator.

As a further aid to the pilot of the "mother" craft or the ground operators, visual location of the robot is helped by a smoke-generating system, which emits a trail of smoke from the robot plane for tracking purposes when desired. Bell Aircraft Corporation.

Pilotless, jet-propelled P-59 Airacomet, flying by radio control from a similar aircraft used as the control station. The light-colored lower craft is the robot.

Rubber-Insulated Trolley System

A fully rubber-insulated trolley system is suitable for almost every type of electrically operated mobile equipment, such as cranes, monorails, portable tools, etc. It is designed to prevent accidents, injuries, and fatalities caused by exposed conductors. The TracTroly system consists of a copper conductor in standard 10-ft. lengths, encased in a slotted rubber rack supported by a rigid backing; and individual traveling collectors that employ an endless chain, like a tractor tread, to effect positive six-tooth multiple contact at all times. Thus, arcing and pitting, as well as fire and explosion hazards are eliminated. Repeated replacement of ordinary trolley wheels and shoes is said to be overcome because of the low-wear factor of this system. Benbow Manufacturing Company, San Francisco.

XF8B-1 Is Versatile Fighter

The Boeing XF8B-1 was designed for use as a fighter, torpedo plane, bomber, attack plane, interceptor, or in many combinations of these types.

The new fighter is equipped with a $13\frac{1}{2}$-ft. diameter Aero-Prop counter-rotating propeller driven by a 28-cylinder Pratt & Whitney air-cooled engine which provides a maximum of 3,600 hp. and a service ceiling comparable to that of the Flying Fortress or the Superfortress. Armament consists of six 20-mm. cannons mounted in the wing, which are sighted by remote control. Six 0.50-cal. machine guns may be substituted for the cannons without any structural change in the plane. Substantial armor protection is provided.

Among the many unusual features attributed to the new fighter are a quick-change power unit containing the engine and all engine accessories, for ease of maintenance; retractable tail wheel and arrester hook; and unit radio equipment that can be readily installed or removed from the plane. Boeing Aircraft Company.

B-50 Bomber

It was disclosed that advanced models of the B-29 Superfortress, which will be produced in limited quantities for the Army Air Forces during 1946,

will be known officially as the B-50. Whether or not the B-50 will retain the name of Superfortress has not been indicated.

The B-50 will have Pratt & Whitney engines of 3,500-hp. maximum rating, and will use reverse-thrust propellers. Its wings will be made of lighter metal than those of the B-29 and it will have a lighter-weight landing gear with ball-bearing type retracting mechanism. The nacelles have been redesigned to incorporate maintenance improvements. New and larger tail surfaces will be installed. Boeing Aircraft Company.

New Bore-Gage Uses Electronic Principle

An electronic bore gage utilizes direct contact to measure the diameter of tube, gun, and other cylindric interiors with an accuracy of 0.00005 in. The new gage, comprising a projection rod mounted on a stabilized frame and containing a delicate, flexible point, is inserted into a bore where it checks by contact all interior surfaces. The results of the test are transmitted instantaneously to a Brown ElectroniK precision indicator. This instrument, featuring continuous balance, picks up and indicates various imperfections, air pockets, and other unwanted conditions to 0.00005 in. The Brown Instrument Company.

Dual-Valve Aircraft Fuel Pump

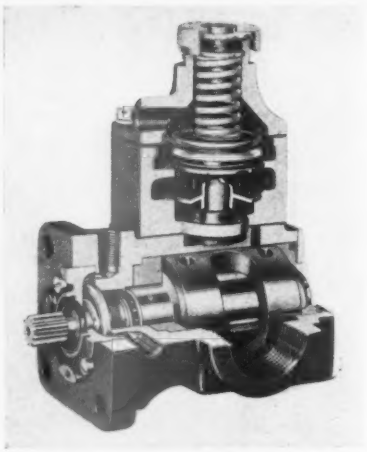
Incorporating two relief valves, a new aircraft fuel pump presents a departure from conventional design. The dual valves, working on a common guide pin, balance each other and make possible pressure regulation within limits said to be unobtainable with other types of valve control.

The pump is credited with being able to hold discharge pressures within $^3/_4$ lb. per sq.in., plus or minus, of the initial setting. Called the Titan Dualvalve, it is manufactured in two models, with respective capacities of 830 and 1,600 gal. per hour at 2,500 r.p.m. Pressure adjustment is from 5 to 35 lbs. per sq.in. and the dual valves assure the discharge being held closely to the predetermined setting. The pump has been designed and built to Army-Navy specifications. Its valves can function without impairment or interruption at temperatures as low as −65°F. Candler-Hill Corporation, Detroit.

Centrifugal Casting Machine

A new Master model centrifugal casting machine has been designed and built for heavier off-balance loads, continuous high production, and free-spinning power. It has a net weight of 3,700 lbs. and is so designed that the standard 24-in. spinning head may be extended up to 60 in. in diameter by the installation of an adapter plate. Molds may be stacked to any workable height.

The hub of the Master model Centri-Meco centrifugal casting machine is turned from 7-in. mechanical tubing of $^3/_8$-in. wall thickness. It has a feature that provides for continuous operation



Cutaway view of the Titan Dualvalve fuel pump.

with permanent molds attached directly to the heavy table mounting-plate. The heavy table has four strut-vanes which act as a fan to carry away the excess heat that is radiated above the top bearing. It is claimed that this type of hub and table construction holds the temperature in the bearing area at no greater heat than 125°F.

Protective hoods and spill pans, constructed of 10-gage sheet steel according to individual specifications, and their telescoping feature, make possible adjustment to any height from 8 in. upward as needed.

The motor mounting of the casting machine is adjustable to standard belt lengths, permitting variation of speeds by changing the drive sheave, so that almost any desired speed may be obtained from 400 r.p.m. to motor speed. Several types of variable-speed controls, at additional cost, from 218 to 1,750 r.p.m. make it possible to deliver constant torque continuously. Intermittent operation is also possible from zero to 218 r.p.m. Dynamic braking is available; mechanical braking is obtainable at nominal extra charge.

Electronic drives may be installed on custom-built casting machines where greater ranges of speeds are needed. Centrifugal Machine & Engineering Company, Kalamazoo, Mich.

Aircraft Lubrication Charts

Pilots and airport operators are looking to oil companies for correct lubrication instructions. To meet this need and to ensure correct application of oils and greases, an aircraft-lubrication chart program has been instituted. Lubrication charts in the program refer to private planes in operation prior to the war and those manufactured in large quantities for the armed forces.

A feature of the charts is the diagram, a phantom perspective illustration of the airplane. All points to be lubricated are identified and located by arrows, and lubricants and intervals are indicated. Detailed instructions are given for lubricating the various parts of the plane.

The Chek-Chart Aircraft Lubrication program consists of 33 charts covering 111 models of 22 different makes of civilian aircraft. These are bound in book form, with four pages of aircraft-lubrication and service instructions covering accessories and component parts, and a page of tabular material on the engine-oil recommendations for nine makes of aircraft engines. As new planes are manufactured, additional charts will be produced for insertion in the book. Chek-Chart Corporation, Chicago.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

Large-Diameter Blind Rivets

To meet the need for larger diameter blind rivets, three additional diameters, $^7/_{32}$ in., $^1/_4$ in., and $^9/_{32}$ in. are now being manufactured. These rivets are available in the three standard types, self-plugging, regular hollow, and pull-through hollow; with modified brazier and 100° countersunk heads; in Al7ST or 56S aluminum alloy, and in steel.

To install these larger rivets, a pneumatic-hydraulic gun, the G-40, is now being produced. It operates on from 75 to 90-lbs. air-line pressure, is 13 in. high, and weighs 7 lbs. The gun is balanced for easy one-hand use in any position. Cherry Rivet Company, Los Angeles.

Results of a Survey of Air Transportation

A recently completed aviation survey among New York business concerns reveals the possibility of a 50 per cent increase in domestic passenger travel, increased air travel to South America and Europe, a great increase in freight shipments by air, and the acquisition of fleets of small planes by business concerns. In the passenger field, the chief reasons given why air travel is not used more often showed that 46.6 per cent of those replying to the questionnaire feared flying, and 8.6 per cent reported that their families objected. Another 8.6 per cent said the higher costs of air travel kept them on the ground, but 27.6 per cent reported they planned to use air travel more extensively.

Of eight geographic areas listed in the questionnaire, 40.4 per cent of the replies indicated most of their air travel would be to Latin America, while 30.3 per cent indicated Europe and 10.1 per cent designated the Far East, followed in order by Alaska, Africa, Australia,

the Middle East, and the South Pacific. If accommodations and rates for foreign travel are equal, 93.8 per cent declared they would use United States airplane services.

Ninety per cent of the answers indicated increases in annual travel ranging from 27 per cent to 1,900 per cent. The amount of traveling would run from a few to 30 trips per month. La Guardia Field was the preferred airport, with Newark second.

Thirteen per cent of the replies announced contemplated purchase of from one to 20 planes, ranging in size from two to twelve passengers and costing from $4,500 to $25,000 each. Seventy per cent of the planes would be used for passengers only, 10 per cent would be used for cargo only, and 20 per cent would be used for both passengers and cargo. Regular schedules are expected to be maintained by 12.5 per cent; the others would use their planes only as need arose.

It was indicated that, if air-mail parcel post becomes available, 40.9 per cent would use this facility in annual volume ranging from small parcels to 100,000 lbs. If present international air-express rates were lowered 50 per cent, increased shipping by this means ranging up to 400 per cent would be used by 69.4 per cent.

Many suggestions were made for improving service, schedules, etc., for passenger, express, or freight service, and for administration and operation. Among suggestions for improvement of passenger service, the following were typical: the difficulty of obtaining reservations should be removed; air lines should provide alternate rail travel in case of trip cancellation; coordinated air and bus service should be provided to reach points not served by direct air service; accessibility of airports is the main need; more feeder lines are needed; a reasonable deadline for reservations should be established instead of requiring reservations months in advance, but subject to cancellation within hours; frequent trips daily on short runs are needed; better and faster methods of handling passengers and baggage to and from airports should be developed; a ticket should entitle the passenger to a seat on the plane, weather permitting, otherwise on the next plane; downtown New York bus service should be provided; make it easier to contact reservation clerks by phone to make rapid reservations.

For express or freight service, the following requests were typical: better pickup and delivery service; payment of brokerage fees to bonafide forwarders; notification of delays because of weather, etc., should be sent by wire.

Administration and operation received the following comments: ticket procurement and return reservations cause the most difficulty; speed up travel from airport to business district; simplify interline tickets and baggage checking; provide a consolidated ticket office in downtown New York City; provide better desk service for reservations and checking in of passengers; speed up ticketing and checking luggage. Commerce and Industry Association of New York, Inc.

Airplane Jack

With the new "Quik-Lift" airplane jack, a slight downward push on the handle easily lifts the wheel of a plane. Changing a flat tire no longer requires the work of two men. A ratchet automatically locks the jack in place at the desired positions. Then a pull on the trigger at the handle releases the jack and lets the wheel down slowly and gently.

The jack is made of lightweight, welded aircraft tubing. An easily attached wood base is optionally available, for use on soft ground. Consolidair, Inc., Alliance, Ohio.

Portable Furnace for Preheating of Magnesium Sheets

How the installation of a compact portable furnace eliminated a complicated arrangement for the preheating of magnesium sheets was demonstrated recently. Operations required the preheating of magnesium sheets before pressing and forming. To do the required work a special furnace was designed. Portability being one of the prime factors, the furnace was provided with large easy-rolling casters to enable the unit to be moved from one press brake to another as operations demanded.

By introducing heat into the furnace from the top and the bottom and with recirculating ducts on both sidewalls, uniformity of within ±5°F. was obtained. This system allowed even heating of the sheet whether in a flat condition or in a partially formed shape in the event the entire forming operation could not be completed in one press operation.

Smooth, fast-operating vertical lift doors at each end of the furnace permit rapid handling of the sheets in order to prevent cooling before forming. Doors are so arranged that they seal against the furnace body when in closed position, keeping heat from the operator. By having a fan of large capacity, over 40 air changes per min. are obtained in the furnace. Despatch Oven Company, Minneapolis.

The XB-42 Bomber

The Douglas XB-42 is a 35,702-lb. midwing, tricycle-gear airplane powered by two Allison V-1710 liquid-cooled engines mounted in the fuselage and using "centerline thrust" from counter-rotating, coaxial propellers located at the extreme rear of the fuselage, behind the tail surfaces. Elimination of engine, nacelles, and propellers from the wings is stated to make possible maximum aerodynamic cleanliness, wing efficiency, and safety of operation.

The engines have a take-off rating of 1,820 hp. each with water injection. They are located just aft of the pilot's cockpit in the fuselage and are connected to the dual-rotation propeller reduction gear by steel drive shafts. Five-foot lengths of shafting are hinged at each joint by ball-bearing supports which provide for air-load deflections of the fuselage. Each propeller is independently driven and either propeller can be feathered when desired. Single-engine performance is efficient, since both propellers are located on the centerline of the airplane and no adjustments in trim controls are necessary for single-engine flight. Douglas Aircraft Company, Inc.

Lightweight All-Plastic Battery Container

Recently made available for general aircraft use, an all-plastic battery container, weighing less than 10 lbs., houses the specially designed 12-volt storage battery used on the jet-propelled P-80 Shooting Star. Fabricated of transparent Lucite methyl methacrylate resin, the container is said to be easy to install and remove. It is also credited with possessing good heat and acid resistance. The plastic offers a 20 per cent reduction in weight compared with other containers and is sturdy enough to withstand any shocks incident to normal handling.

The fabricating method requires milling the plastic to an overall tolerance of $\pm 1/32$ in. to ensure a tight fit in the

The Douglas XB-42 bomber.

Big airline orders for the MARTIN 202!

What's the big news in aviation today? The Martin 202! Right now, large initial orders for the 202, totaling millions of dollars, are on Martin's books. And this is only a beginning! More and more airlines are signing up. Record-smashing domestic and foreign sales are in the making. And in 1947 Martin will be turning out the 202 at a rate of 50 a month! Martin sets the pace for postwar air travel! It's the plane that most nearly meets ATA specifications for a twin-engined, medium-range transport. It obsoletes any plane of its class now flying. And it's backed by Martin's 37 years of advanced aircraft design! No wonder the airlines are piling up orders for the new Martin 202!

Here's Performance Plus!

Years ahead of the field, the Martin 202 flies 100 m.p.h. faster than today's transports . . . offers comfort unsurpassed by even the largest 4-engined craft . . . cuts operating costs to the marrow. This plane is not just designed *for* the airlines. It's designed *by* the airlines . . . custom-built by Martin . . . to the most exacting standards of the air traveler.

Martin
AIRCRAFT
Builders of Dependable Aircraft Since 1909

THE GLENN L. MARTIN COMPANY • BALTIMORE 3, MARYLAND

plane, with some component parts held to a tolerance of ±0.001 in. Side rails, used for sliding the battery into place, are constructed separately and cemented to the sides of the transparent housing. The makers of the battery report that they are now working on the problem of molding the entire 9¾-lb. container in one piece. E. I. du Pont de Nemours & Company (Inc.).

Lightweight Generator

A generator weighing only one-half as much as formerly available equipment but capable of supplying up to 1,200 watts in continuous duty is announced. Originally developed as an air-borne unit for remote radar stations, this specially designed unit has a maximum weight of 20 to 25 lbs., depending upon rating. Available in 500-, 600-, and 1,200-watt capacities, at 32 and 120 volts, 50° temperature rise, the generator is of the totally enclosed, glass-insulated type, equipped with lifetime-lubricated ball bearings.

It can be supplied as a two-bearing unit or with a single bearing for direct-drive applications. An integral panel with meters and voltage regulator is also available. Small in size, light in weight, and built for continuous-duty operation, this unit can be applied for auxiliary-power generation as well as for primary power. Electrical Engineering and Manufacturing Corporation, Los Angeles.

Complete Enclosures for Electrical Components

Round or square enclosures for electrical components—relays, coils, transformers, etc., are available with or without equipment-mounting bridges attached to the can interior. Can lengths to 6 in. are supplied. Terminals are brought out through sealed headers in the base. The headers can be supplied for plug-in use.

Round cans may have any number of contacts up to a maximum of eight. Square cans have a maximum of 14 leads. These new enclosures are offered as a compact, economical, and efficient method of encasing components. Units so housed are easily replaced or serviced. Complete protection is afforded from dust, dirt, and moisture, as well as excellent protection from mechanical damage. Electrical Industries, Inc., Newark, N.J.

Air-Operated Speed Chuck

A new air-operated collet-type speed chuck is claimed to be accurate over a collapsibility range of 1/32 in., thus eliminating the need for seven standard single-purpose collets. Simple in design, it incorporates the Erickson holding principle of accurately mating angles of chuck shank and collet for greater accuracy and gripping power.

Available in either foot-valve or hand-operated models, and adaptable to any spindle, the Model 4AT range is 1/8 in. to 1 in. Model 6AT range is 1 in. to 2 in.

This air-operated speed chuck is credited with speeding chucking operations and requiring little maintenance. Erickson Tools Division, Erickson Steel Company, Cleveland.

Test Oscillator

Details of a portable test oscillator, a device that aided in ensuring satisfactory operation of U.S. Army and Navy radar equipment and in jamming enemy radar systems, have been announced. This instrument has also been used in connection with radio operations. By means of it, radio sets on battlefields and in airports have been quickly and accurately checked and adjusted to operate on specific wave lengths.

An original design of the National Defense Research Council's radio research laboratory and the General Radio Company, but redesigned for quantity production, the test oscillator represents an accomplishment in volume manufacture of individually calibrated units. Its design is such that variations attributable to temperature changes, whether atmospheric or caused by operation, are minimized. The test oscillator consists basically of a small lightweight instrument mounted in a carrying case.

Primarily designed to provide a source of calibrated high-frequency signals for testing in the field, the test oscillator delivers a small fraction of a watt, which is sufficient for test but which at the same time is not enough to interfere with other radio equipment in the vicinity. Using a conventional triode, it covers the frequency range in two bands, 40-115 megacycles and 115-500 megacycles. An adjustable pickup loop provides control of the output power. Either an unmodulated or a modulated signal can be obtained. The modulation may be either 1,000-cycle sine wave at about 50 per cent modulation or a special short regulated pulse used in certain classes of equipment. Fairchild Camera & Instrument Corporation.

Simulated Targets for Camouflage Purposes

It can now be reported that during wartime an important part of military strategy was the use of inflated targets. These consisted of inflated imitations of airplanes, half-tracks, and tanks. The inflated targets were designed by Army camouflage experts to create the illusion, from the air, of actual mobile armament. Constructed of rubber tubing skeletons, the framework was covered with olive-drab colored canvas with proper unit insignias and numbers.

It was possible for tacticians to place an entire "army" in the field at some point which would serve to confuse enemy observers, while the actual armed unit moved under the cover of darkness or camouflage to some point isolated from the illusionary army.

The targets were subject to rigid tests which required that, when once inflated, they maintain a pressure sufficient to continue the illusion of actual field pieces over a specified period of time. The Firestone Tire and Rubber Company.

Aircraft Brake with "Built-in Cooling System"

Introduction of a compact aircraft brake with a "built-in cooling system" has been announced. Excessive temperature, with its attendant problems of rapid wear and distortion of brake parts, leakage of hydraulic-system rubber parts, and tire and tube deterioration, is said to have been overcome through the development of the new brake. High kinetic energy values per pound of brake weight are attributed to the new development, together with six advantages. These are (1) elimination of fading; (2) quick cooling; (3) reserve capacity; (4) quiet, smooth action; (5) low maintenance cost; and (6) compactness. The Firestone Tire and Rubber Company.

Arc-Welding Aid

A new arc-welding compound is designed to aid in instantaneously creating and maintaining a metallic welding arc where low currents and small-diameter electrodes are employed. Known as Strike-easy, this compound is said to be easily applied and usable for any kind of metal with any type of electrode.

The compound, which is in paste form, is available in 1-lb. glass jars. No mixing or other preparation is required. General Electric Company.

Automatic Control of Machine-Tool Operation

An "electronic finger" automatically controls the operation of machine tools by "feeling its way around" the angles and curves of a pattern. The feeler, or tracing stylus, comprises, in electrical terms, two magnetic bridges, each consisting of two identical magnetic circuits, one pair mounted on an axis at right angles to the other pair. The four magnetic poles are assembled on a diaphragm which is fastened to the stylus, a fingerlike projection that touches the pattern or template.

In operation, the stylus of the tracing head is moved against the side of the contour on the pattern to be reproduced. The extremely slight pressure of the feeler against the template causes a deflection of the diaphragm, which in turn creates a change in voltage in the coils of the tracing head. This voltage is then carried to the "brain" of the entire device, where the signals from the bridge circuits are amplified many times and "mixed" into a vector signal. This signal causes the stylus to be driven against the template and, as the deflection of the stylus increases, the vector signal is shifted by a "bender" circuit to cause the stylus to move along the surface of the template with a uniform deflection.

The signal from the "bender" circuit is sent into a translator circuit which

produces two separate d.c. voltages. Each voltage determines the speed of one of the two feed motors. These voltages are so coordinated that the resultant speed of the stylus around the template is constant, regardless of the direction. When a change in contour is encountered, one motor will automatically slow down or speed up just the proper amount to reproduce on the piece of work in the machine the same contour encountered by the stylus on the pattern. Either an inside or an outside angle can be cut in this manner.

Because the "bender" circuit of the device provides complete control over the movement of the tracing head, it is reported to be impossible for the stylus to stray away from the template. The instant such a tendency occurs, the vector signal automatically forces the head against the pattern, ensuring not only a constant degree of accuracy in pattern reproduction but a continuous cutting operation on the most complicated of parts.

Provisions are made on the master control panel for remote nonautomatic operation of the contour equipment. By merely pushing a button, an operator may release the automatic control and take over the operation of the machine himself. With this method, the speed, direction, and control of the motors are handled by the operator through a system of push buttons and dial controls on the master panel. There is no danger of overcutting the pattern, even manually, because when the stylus touches the pattern, the automatic control takes over and follows the template until the operator again takes control. This manual operation is particularly advantageous in following an outline pattern instead of a cut-out template. The operator can then direct the tracing stylus over the drawn diagram in pencil fashion, and the motors will take care of moving the machine to follow the stylus.

Simple to operate, the new control can be applied to many different types of metal-cutting tools. It is capable of a variety of intricate cutting operations which, if done by complete manual operation, would involve many separate directional cuts and endless gage checks.

During the war, machines equipped with this automatic contouring control turned out many complicated parts for jet aircraft engines and turbosuperchargers. General Electric Company.

Cushioning Meter Measures Packing Efficiency

A cushioning meter offers a simple, rapid, and dependable means of determining the correct type, amount, and distribution of cushioning material to protect any article in shipment. This meter applies scientific test methods to the evaluation of packing systems, and measures, in standard terms, the shock experienced by the object packed, thus checking the effectiveness of the packing system.

The unit consists of a detector head and an indicator. The detector head contains an electric mechanism that responds in varying degrees to shock experiences. This response is transmitted through a flexible cable to the indicator, on which it is registered by the energizing of neon glow lamps marked to correspond to the peak shock expressed in *g*. It registers shock in twelve steps covering a range of 10 to 100*g*. Indication is accurate to 1*g* on any step. The indicator circuits operate from the self-contained 110-volt, 50/60-cycle, a.c. power supply.

In operation, the detector head is attached to a mock-up of the article to be packed, thereby eliminating the danger of damaging delicate or costly instruments or equipment in testing their packing. After being attached to the unit, the mock-up is dropped on a hard surface and the peak shock is read from the indicator. The lamps on the indicator circuit glow until a manual reset button is pressed, hence the operator need not watch an instrument pointed to catch a peak deflection.

Indicator and power supply are housed in a carrying case with a hinged cover and a leather handle. The indicator case is $16\frac{1}{2}$ by 11 by 9 in. and weighs 17 lbs., and the detector head only 2-in. square by $\frac{5}{8}$-in. thick, weighs $\frac{1}{2}$ lb. General Electric Company.

"Baseball"-Type Parachute

A nonoscillating-type parachute developed during the war is revealed as having been a key factor in wiping out German submarines during the "Battle of the Atlantic." The new parachute was used to drop the Navy's delicate electronic sonobuoy signalling device from planes into the ocean where submarines were known or suspected to be. The buoys were dropped in patterns and the signals they broadcast provided an exact bearing upon the subsurface raiders.

As dropped by "baseball" parachute, the sonobuoys floated down to the water without any of the familiar side-to-side swinging motion. Until its elimination, oscillation was a serious cause of damage to sonobuoys, the delicate electronic tubes frequently being knocked out when the buoy hit the water while swinging like a pendulum.

The planting of sonobuoys was one of the most secret uses of the "baseball"-type chute. The design is now being applied to peacetime use in cargo dropping and other fields.

The parachute used to drop the buoys was 24 in. across, with a canopy of cotton cloth. The buoy was freed from the parachute by a "bottom release." As the bottom of the sonobuoy struck the water, the slight impact activated a spring that instantly released the chute, leaving the buoy ready for action.

Adaptability of the baseball parachute to any cargo assignment is viewed as favoring its use by civilian air-transport lines wishing to make deliveries without landing. The design was found to open smoothly and to function without oscillation under any conditions of load, wind, and flying speed.

The "baseball" designation of the hemispherical parachute is traced to the pattern of the basic seams of the canopy, which resemble the pattern of a baseball cover. General Textile Mills, Inc., Carbondale, Pa.

Water-Ballast "Pickup" for Airships

Experiments to perfect a method by which airships can increase their efficiency by picking up water for ballast while in flight are being conducted by the Navy in cooperation with the Goodyear Aircraft Corporation, with the Coast Guard also assisting.

The device being tested consists of a torpedo-like "fish," containing a small electric pump, which is towed under water by the airship at a speed of about 50 m.p.h. and from a height of less than 100 ft. A hose carries the water pumped by the "fish" up into the airship's ballast bags and also serves as a conduit for the electrical connections.

Any lighter-than-air ship grows lighter as it consumes fuel, and various devices have been used to offset this increased buoyancy. Condensers have been installed to convert exhaust fumes into water, thus recovering enough weight to counterbalance that of the gasoline consumed. Small troughs also have been built alongside the airship's envelope to catch rain and divert it into the ballast bags. The method now under test is considered potentially superior to either of these devices.

The present experiments, which are being carried on over Lake Erie with Navy and Goodyear observers both in the airship and in an accompanying Coast Guard boat, are designed to determine the most efficient type of "fish" to be used. Goodyear Aircraft Corporation.

Spherical Bearing

The Halfco spherical bearing is now off the critical-materials list and is available in any quantity to manufacturers of equipment or engines using self-aligning bearings or rod ends with self-aligning bearings installed.

This spherical bearing features high load capacity, ability to operate under a high degree of misalignment, and great projected bearing area. Made from a one-piece bronze outer race into which is pressure-inserted a hard-chrome plated steel ball, the bearing can be used whenever alignment is costly or impossible to attain, or wherever rigidity is required. Halfco Engineers and Manufacturers, Los Angeles.

Light for Visual Inspection of Hard-to-Get-at Places

The Eder-Lite, miniature inspection lamp, makes it possible for inspectors, engineers, mechanics, scientists, and others whose work requires inspection of inaccessible places, to light up and visually inspect cylinders, gear housings, tubes, pipes, and other equipment

that have openings as small as 5/16 in. and recessing interiors. Small light-reflecting and glareless metal-protected tungsten bulbs attached to a flexible or rigid extension make clear vision possible and enable a maximum amount of light to be focused on the proper place.

This miniature inspection lamp is manufactured to protect the user against shock by supplying the power through a rubber insulated wire cable to a transformer enclosed in a Bakelite handle. The Eder-Lite can be supplied in a special model to provide complete safety in fields where there is danger of explosion or fire.

The standard set consists of a built-in, push-button type transformer lamp handle constructed for a.c. power, a 10-ft. plug-in cord, two rigid and two flexible extensions of varying length that can be used in combination or separately, and four screw-in miniature tungsten bulbs of varying sizes. Special lamps, cord lengths, and mounting or hand brackets may be obtained. A small, attachable reflecting mirror, similar to a dentist's mirror, is also available for inspection of areas not in direct line of vision. Harmon and Company, Chicago.

Heavy-Duty Die-Casting Machine

The fourth basic model of a line of die-casting machines is a heavy-duty, high-capacity cold-chamber type. In it provision is made for the addition of a hot chamber furnace and an injection attachment so that the machine also may be used for automatic high-speed casting of zinc, tin, or lead alloys.

Like the other machines in the series, this one has a hydraulic system providing hydraulic pressures from 200-lbs. per sq.in. to 1,000-lbs. per sq.in. delivery which may be regulated by the operator of the machine, depending upon the pressure requirements of the casting to be done. Locking pressure on the dies is automatically compensated for increase and decrease of the injection pressure. The centrifugal pump is driven by a 15-hp. motor. The load on the pumping unit is not constant as is the case with most hydraulic systems, placing the pumping unit under high load only when the machine is in operation. In the event high-speed output is not required, one hydraulic system can be used for more than one machine, each machine operating in proportion to the hydraulic system capacity of 400 cycles per hour. H. L. Harvill Manufacturing Company, Los Angeles.

Multipurpose Grinder

The new design of the Model ACX multipurpose grinder has the wheel head mounted on two different compounds, each graduated to 180°, thereby permitting difficult internal or external taper grinds or turns to be done easily and accurately.

Another important feature is that the workhead can now be moved 6 in. toward or away from the work, by simply removing and replacing four screws. By so doing, the swing can be increased from 18 in. to 30 in., greatly increasing the number of jobs that this machine can handle. It has both hand and power cross-feeds, a work-length capacity up to 8 in., and two reversible spindle speeds of 80 and 130 r.p.m. Chucks are quickly and easily mounted on the face plate by a draw bar that extends through the spindle. The wheel head has a 2-hp. motor with ball-bearing spindle, and speeds of 6,000 and 12,000 r.p.m.

A retractible tool-holder bar enables finished grinding to follow turning operations without removing the cutter. The power cross-feed can be set to any desired length by dogs on the side of the carriage. Longitudinal feed is controlled by a quickly interchangeable screw or rack and pinion. An automatic sizing device ensures exact duplication of successive pieces on production runs. Lempco Products, Inc., Bedford, Ohio.

Airplane "Safety" Starter

A mechanical starter has been developed which is said to eliminate the hazards of spinning an airplane propeller by hand. Adaptable to any light-plane engine, the safety starter reportedly takes no unusual skill to install and does not impair in any way the speed and operation of the plane. It is operated by simply pulling a "starter" lever.

Complete installation of the mechanical propeller-starter includes an impulse magneto and the starter complete with lever, a total weight of only 12 lbs. The device is designed to fit under a streamlined cover. McDowell Manufacturing Company, Pittsburgh.

Hand Bending Tool

A new hand bending tool permits all kinds of small tubing to be curved to any desired angle. It consists of a sturdy steel base that may be used in a vise or clamped onto a bench; a revolving radius rod equipped with a handle for turning; a stop block grooved to hold the tubing; and a movable radius block that guides the tubing around a bend roll centered on top of the base. This roll, cylindric in shape and also grooved, has a top plate scribed in 360°. A measuring point is marked on the movable radius block. The radius and holding blocks and the roll are so grooved as to prevent crushing or change in section of the tubing.

Tool for hand-bending of small tubing, used at The Glenn L. Martin Company.

Allowances can be made for tubing having a "spring-back" characteristic by moving the measuring point to as many degrees beyond the desired angle marking as the tube will spring back when released. An operator can measure the amount of allowance needed from the spring back shown on the top plate of the bend roll, when pressure on the handle is released.

By the substitution of a set of phenol fiber blocks, similar in design to the metal blocks, hot-dipped or tinned spiral electrical cables (for example, battery cables) also can be bent in the new tool. Use of the phenol fiber accessories prevents the semimolten coating on the wire from adhering to the blocks, as would be the case with use of the steel blocks on the original tool.

Chief advantages of the new device are the great amount of time saved as compared with ordinary hand bending operations, the accuracy to which the tubing can be turned, and a material saving in that there is no scrap caused by the tubing being crushed or split during the operation. The Glenn L. Martin Company.

Electronic Device for Anodizing Rivets

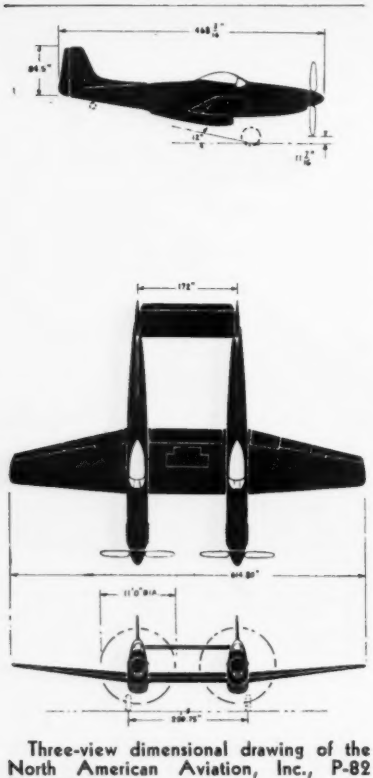
Attached to a standard rivet sorter, an electronic device has been the means of improving the methods of anodizing rivets, increasing the output and reducing man-hours. This is a device of low voltage, with a magnetically operated lever that is energized by completing an electrical circuit between the plate and the contact point. As the rivets pass through the separator, the contact point touches the head of the rivet, and if the rivet does not come up to anodic specifications, a small relay is energized and the relay throws out the rivet. The Glenn L. Martin Company.

P-82 Twin Mustang

The North American Aviation P-82 Twin Mustang was designed for long-range duty and is credited with a top speed of more than 475 m.p.h. It is reported to be able to cover the Pacific stretch between the West Coast and Pearl Harbor on a nonstop flight.

Production of the P-82 will supplant production of the P-51H Mustang at North American Aviation's Los Angeles plant. Tactical versatility of the plane is said to fit into long-range peacetime work, since it incorporates design features developed by continued engineering and research efforts to improve American aircraft.

A departure from the conventional single-fuselage airplane, the Twin Mustang is formed by two fuselages joined by the wing and the horizontal stabilizer. With a pilot in each fuselage



Three-view dimensional drawing of the North American Aviation, Inc., P-82 Twin Mustang.

and an automatic pilot in the main cockpit, it reduces the problem of pilot fatigue on unusually long-range missions.

Powered by two Packard-built 12-cylinder V-1650 Rolls-Royce engines, each generating 2,200 hp., the Twin Mustang is claimed to operate efficiently up to 45,000 ft. The power plants are equipped with a two-speed, two-stage aftercooled supercharger on each fuselage, and each engine has a manifold-pressure regulator and water-injection system. The plane utilizes two counterrotating, full-feathering four-bladed Aeroproducts propellers.

The two fuselages are carried on the center wing section, which is fitted with a single, slotted-type wing flap, and with provisions for machine guns and bomb racks. The outer wing sections have removable tips, aileron-type wing flaps and fittings for bomb racks and rocket launchers.

A feature of the twin fuselages is the four-wheel landing gear arrangement, consisting of two main gear assemblies and two steerable tail wheels. The main gear is normally operated by hydraulic pressure from the left cockpit only. Emergency operation through a mechanical system is possible from either cockpit. A cable system extending from each main gear through the fuselage retracts each tail wheel. Steerable through the rudder control system, the tail wheels are free swiveling when the control stick is pushed forward.

Each fuselage has a short rear section actually forming a part of the empennage, which consists of two vertical stabilizers and rudder assemblies linked together by a single horizontal stabilizer and elevator assembly. Dorsal fins fair the vertical stabilizers to the fuselages to improve directional stability.

The elevator and rudder control systems include a hydraulic power boost mechanism that automatically cuts in to assist the pilot in more violent maneuvers and pull-outs. Each pilot has complete primary and empennage trim-tab controls, while the aileron trim tab is controlled from the left cockpit only. Complete elevator and rudder control systems in each fuselage are interconnected through the center wing section, as are the complete aileron control systems incorporated in each outer wing panel.

The control stick in the copilot's right-hand cockpit is removable, and the rudder pedals in either cockpit can be disconnected in flight and moved out of the way to provide more room for the pilot who is not flying the plane. The pedals snap into place when pulled back. Both engine throttles and both propellers are controllable from either cockpit by manually operated levers. The pilot's cockpit at the left contains the normal flight and engine instruments, including automatic pilot controls, while the copilot on the right has sufficient instruments for relief and emergency operation. A simplified cockpit arrangement has been designed to improve pilot comfort, including a tilting, adjustable seat to reduce fatigue during long flights.

The Twin Mustang's armament consists of six machine guns, 25 rockets, and four bombs. Six free-firing 0.50-cal. machine guns are located in the center section with space for 400 rounds of ammunition for each gun. A compensating gun sight is installed in the left cockpit, and a fixed sight in the right cockpit.

The plane has four bomb racks, one on each outer wing and two on the center wing section, each able to carry a 1,000-lb. bomb. Adapters fitted to the center section racks make it possible to carry two 2,000-lb. bombs in that position. Normally, the bomb racks are electrically operated from the left cockpit, but in emergency all bombs can be salvoed by mechanical release from either cockpit.

Five rocket-launching racks carrying five rockets each give the Twin Mustang a fire power comparable to a light cruiser's full broadside. Two racks are on each outer wing panel and one in the center section. The rockets can be released from either cockpit and are fired at intervals of $^1/_{10}$ sec. each.

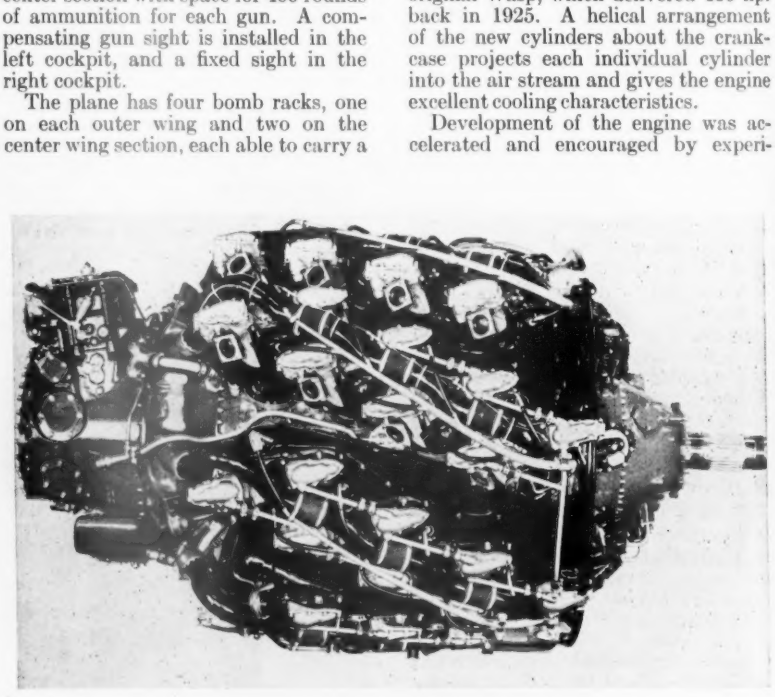
To increase the P-82's range, a special shackle in the center of the center wing section will carry a 450-gal. droppable fuel tank. The shackle connection can also be used to add to the fire power by holding a special nacelle carrying eight 0.50-cal. machine guns. The entire assembly can be jettisoned in an emergency. Adaptations of the eight-gun nacelle provide a camera installation for reconnaissance flights or radar equipment for night fighting. North American Aviation, Inc.

Wasp Major Engine

The Wasp Major, delivering in excess of 3,650 hp. for combat airplanes, has been selected to power numerous new commercial aircraft, as well as several of the operational airplanes of the Army and Navy.

The Major's 28 cylinders are arranged in four rows of seven cylinders each, giving the engine a frontal area no greater than that of the 18-cylinder Double Wasp. In fact, the new engine is only 1 in. larger in diameter than the original Wasp, which delivered 410 hp. back in 1925. A helical arrangement of the new cylinders about the crankcase projects each individual cylinder into the air stream and gives the engine excellent cooling characteristics.

Development of the engine was accelerated and encouraged by experi-



The Pratt & Whitney 28-cylinder Wasp Major engine, used in numerous commercial, Army and Navy aircraft, develops more than 3,650 hp.

mental and production contracts from both Army and Navy. Because of the urgency of military demands and wartime intensification of engineering activity, less than 5 years have elapsed since the project was authorized late in 1940. The first engine was run in April, 1941. The Major first powered an airplane in flight in May, 1942, and completed its 150-hour qualification test in December, 1944. The design has been subjected to more than 17,000 hours of full-scale development running, exclusive of test running, component engine parts, flight tests, and operation by Government agencies and airplane contractors.

While the basic elements of the Wasp Major's design closely follow those used in service-proved models, among the engineering innovations and improvements are deep-finned, forged aluminum cylinder heads and duralumin cylinder muffs of special design for use interchangeably with tractor or pusher installations; correct cylinder-cooling baffles; the elimination of the conventional ignition harness through the use of seven interchangeable magnetos, one for each bank of four cylinders; a "vibration-free" crankshaft and improved vibration dampers to inhibit vibration from power impulses and reciprocating masses; an improved automatically controlled, hydraulically driven, variable-speed supercharger; and the radial mounting of accessories about the periphery of the accessory drive case, instead of on the rear of the engine, to provide better maintenance accessibility. Dry weight of the single-stage, variable-speed engine is 3,405 lbs. Pratt & Whitney Aircraft Division, United Aircraft Corporation.

Electrolimit External Comparator

By the use of the Electrolimit Comparator, an electric contact unit is combined with the Electrolimit head to produce a unit for accurately detecting product limits. Small neon-tube undersize and oversize lights are positioned at the sides of the meter, requiring only one line of vision for both the lights and the meter.

During the inspection, the operator knows in an instant whether the part is undersize, oversize, or within the limits by watching the limit lights. The minus light on the left, being normally on, will remain so when the part is undersize. When the part is within the determined limits, both lights will remain off.

Should the operator desire to make an actual size reading of any part being checked, it is necessary only to slow up the high-speed gaging operation sufficiently to take the reading on the indicating meter. Pratt & Whitney Division, Niles-Bement-Pond Company, West Hartford, Conn.

Hand Tachometers

New precision hand tachometers enable engineers to read accurately the revolutions per minute of any revolving equipment. These tachometers operate on the centrifugal principle. They have five speed ranges covering a wide range of speeds.

To change speeds, a knurled ring is provided for speedy shifting. The four models are: Model A, from 30 to 12,000 r.p.m.; B, from 45 to 18,000 r.p.m.; C, from 60 to 24,000; and D, from 120 to 48,000 r.p.m. It is thus possible to obtain the speed of generators, engines, belts, elevators, transmission pulleys, power plants, textile machines, pumps, lathes, etc.

These devices gain their precision from the fact that each dial is individually calibrated for each instrument. Revolving shafts can be measured as close as 1 r.p.m. In the Model A, the hand reads to 1 r.p.m. and fractions of one revolution may be estimated. In the 100 to 400 range, each graduation shows 5 revolutions; in the 300 to 1,200 range, ten revolutions; in the 1,000 to 4,000 range, each line represents 50 revolutions; while in the 3,000 to 12,000 range each graduation records 100 revolutions. Attachments are also provided to give feet-per-minute readings.

It is claimed by the manufacturer that with the precise graduations on these tachometers, much closer results can be obtained. George Scherr Company, Inc., New York.

Sine Bar Fixture

The sine bar fixture is a device for checking tapered and angular work requiring a high degree of dimensional accuracy. It consists of a serrated work surface hinged to a base plate, the entire fixture being precision made to a tolerance of 0.0001 in. The work-surface angle is set by using precision blocks as a reference.

The fixture is available in two sizes, 5 in. and 10 in., respectively, between hinge center and setting bar center. The 5-in. fixture may be used on a visual gage equipped with a 6-in. anvil. Either size fixture is suitable for use on a surface plate with a height gage.

An adjustable work stop that may be used on either end of the fixture, and an adjustable backstop usable on either side of the surface plate, are standard equipment. The Sheffield Corporation, Dayton, Ohio.

Lapping Simplified by Roller Lapping Machine

A roller lapping machine, a new mechanical development, is credited with simplifying and speeding the job of lapping and polishing round plugs, pins, or rods. It is stated that this machine turns out highly finished work in approximately one-third of the time necessary with the old "ring lap" method.

The roller lapping machine consists of two precision-ground cast iron rollers that revolve in self-aligning and adjustable bearings. One roller is approximately 3 in. in diameter by 12 in., and the other roller is approximately 6 in. in diameter by 12 in. Both rollers rotate in the same direction (away from the operator at the top of the rollers) at the same r.p.m. They are easily adjusted to accommodate work up to 6 in. in diameter.

In using the machine the most economical procedure is to grind the plug or pin within 0.0002 in. to 0.0004 in. of the desired size and then lap to size. Abrasive compound is placed on the rollers with the fingers or a brush and spread evenly over both surfaces. The work is placed between the rollers; then a notched fiber stick is pressed down on it and moved slowly and evenly from side to side across the plug or pin. If it is necessary to lap off a small amount from any particular section of the plug or pin, the fiber stick is merely kept longer on that section. Friction of the rollers on the plug causes it to revolve and the difference in the surface speed of the rollers brings about a lapping or polishing action. Tapered plugs or plugs with shoulders are handled with equal ease. "Waves" and high spots are removed from the length of the plug or rod by means of the line of contact of the work and the rollers.

With this method no chucks are used. The work may be put in and taken out for checking and measurement without stopping the machine. Since excessive heat is dissipated to a great extent by the large mass of the rollers, a "cooling period" is ordinarily not necessary. Spitfire Tools, Inc., Chicago.

Soundproofing, Loud Speaker Installation, and Radio Data on Voyager 150

Sound levels in the Stinson Voyager 150 are reduced sharply through soundproofing and by muffling engine exhaust noises to a point that conversations in normal tones can be heard throughout the cabin. One result of the quieter cabin is installation of a dome loudspeaker for the radio receiver in place of headphones. Improved radio equipment, use of dual engine mufflers, and efficient cabin soundproofing made the loudspeaker installation possible in the Voyager 150.

External sounds are kept from the cabin by overall structural tightness and the blankets of fireproof Fiberglas insulation which completely cover the cabin except for the windows. The cabin insulation also aids temperature control.

Equipped with both conventional and loop antennas, the aircraft's radio receives aircraft broadcasts on wave lengths from 200 to 410 kc., and commercial broadcasts on a band extending from 550 to 1,500 kc. The radio transmitter, tunable in the range from 2,600 to 7,000 kc., is factory equipped with a 3,105-kc. crystal.

Much of the development of aircraft radio equipment and progress in airplane soundproofing which permits use of the cabin dome speaker came during the past year. While engineers probed possibilities to eliminate noise and keep sounds from the cabin, a small but

powerful radio receiver weighing only 12½ lbs. was perfected. The radio is installed in the Voyager's instrument panel to the left of the pilot's control column. Headphones, if desired, can be plugged into a jack located on the instrument panel. Stinson Division, Consolidated Vultee Aircraft Corporation.

"Chatterless" Countersinks

Made of solid, high-speed steel to assure long life and trouble-free performance, special four-fluted countersinks are designed for use on all kinds of metals. There are two positive and two negative cutting angles ground into the tool. The positive cutting angles pull into the work while the negative angles push away from the work. These simultaneous operations result in a balanced cutting action that automatically eliminates "chatter."

Another feature of design is that these tools are milled not on a spiral but on a direct angle. Thus, cutting action changes from ahead-of-center to back-of-center, with each flute engaged in a progressive action for most effective work.

The countersinks are available in standard angles of 60°, 82°, and 90°, in sizes from ¼ in. to 2 in. Other angles may be made to specifications to meet individual requirements. Tru-Cut Tool Company, Detroit.

Prefabricated "Tee" Hangar

A prefabricated Tee hangar incorporating office and shop space for small operators is included in a group of ready-made airport hangars. One model of the design, which is intended to provide adequate office and tool space for aircraft users at both large and small airports, embodies two large rooms in the rear of the hangar on either side of the space occupied by the tail of the airplane.

It is reported that these hangar facilities will be adequate for flight office, waiting rooms, or even sleeping accommodations for transient pilots. The hangars are delivered either with or without the additional space provisions.

Two different sizes of hangar are being produced at present. The smaller size (Type A), designed specifically for light planes of the Cub type, has a door clearance of 38 ft. by 7 ft. 9 in. high. The hangar is 24 ft. deep.

The larger hangar (Type B), which is large enough for Waco, Stearman, and Fairchild types, has a clearance of 38 ft., height of 9 ft. 9 in., and a depth of 32 ft. Office, workshop, or flight office for this type hangar measures 12 ft. by 16 ft. Outside width of both A and B hangars is 40 ft.

Structural members, sheathing, and roofing are precut, ready for quick assembly, and designed for maximum lightness to reduce shipping costs. The main truss is made of wood and comes in three sections. It is stressed for maximum loads. Rafters measuring 2 by 8 in. are cut and processed for quick erection and the roofing itself is corrugated, galvanized sheet metal. For lightness and low cost the sheathing is made up of sections of Homasote Structural Board.

The doors of the hangars are of the overhead type. Built in three sections, they operate on rollers and are counterbalanced to allow lifting with but little effort. When open, they lie in a horizontal position under the roof trusses. R. H. Washburn Company, Trenton, N.J.

Compact Gas Turbines

Two axial-flow jet propulsion gas turbine engines designed and built by Westinghouse for the Navy were publicly shown for the first time at a recent press conference. One of these was a turbojet power plant 9½ in. in diameter, originally designed to propel an American "buzz bomb," and a high-powered engine designated the "Yankee." Recent models of the Yankee engine are reported to weigh less than ½ lb. per lb. of thrust, a figure representing less than half the weight of present piston engines, and its diameter is only 19 in. It is stated by the manufacturer that the diameter of the Westinghouse turbojet engine is less than three-quarters the diameter of any other jet engine known to the manufacturer, and that the cross-section area is only about one-half that of reciprocating engines.

In predicting the use of reaction-propulsion power plants, it is stated that at speeds of the order of 500 m.p.h. the jet engine expends less than 10 per cent of its power in driving the engine and its nacelle through the air, and that 90 per cent of the power can be applied to propelling the airplane, whereas approximately 40 per cent of the total power of a reciprocating engine is used in overcoming air resistance at such speeds.

The axial-flow compressor, to which is attributed largely the small diameter and light weight of the engine, is an aluminum rotor only 1 ft. long, on which are mounted nearly 200 airfoil blades, arranged in six rows. It rotates at 18,000 r.p.m. and rams 50 tons of air, or more than 1,000,000 cu.ft., into the combustion chamber per hour. The engine, developing approximately 3,400 hp., utilizes a major part of its power in driving the compressor, but it produces 1,400 lbs. of thrust, the equivalent of about 1,400 hp. at a speed of 375 m.p.h., as propulsive energy in the jet stream. Each blade of the turbine "wheel" weighs only 6 oz., but at operational speed its centrifugal force is 17,490 lbs. and the total centrifugal force developed in the rotor is 710,000 lbs.

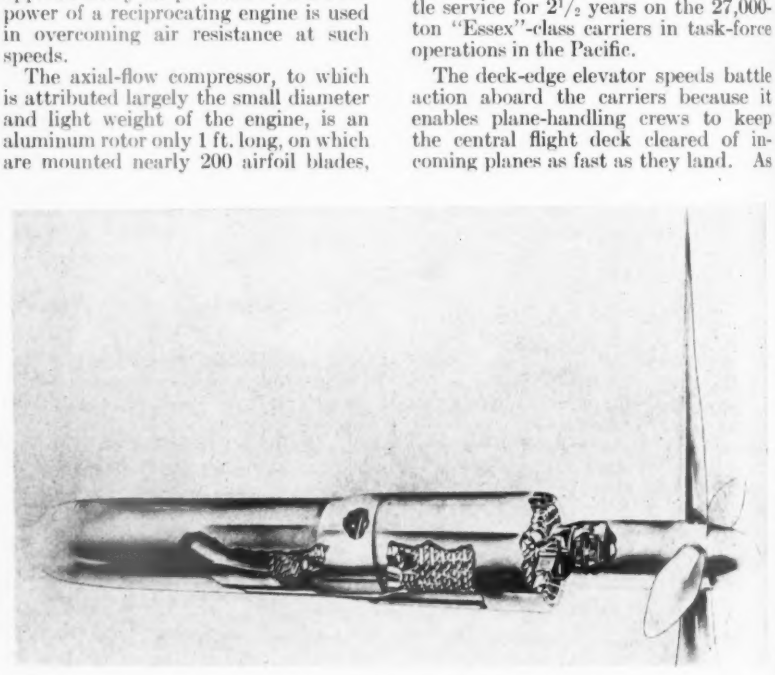
The small turbojet engine has a diameter of only 9½ in., but yields a propulsive jet thrust of 275 lbs., equivalent to about 275 hp. at modern airplane speeds. At full speed the engine operates at 34,000 r.p.m. It has been used to power radio-controlled pilotless "drone" craft launched from Navy planes.

Three additional models, including a gas turbine for propeller drive, are reported to be on the drawing boards or actually undergoing test. It is explained, that because of military necessity, the jet propulsion engine was the first type of aircraft gas turbine developed by Westinghouse, but the company's plans are predicated not on jet propulsion alone, but on both of the basic forms of the gas turbine. Westinghouse Electric Corporation.

Deck-Edge Elevators for Carrier Planes

"Deck-edge" elevators that move planes up the outside of an aircraft carrier to the flight deck in a matter of seconds, are now being installed on the Navy's new fleet of "Midway"-class supercarriers. They have been in battle service for 2½ years on the 27,000-ton "Essex"-class carriers in task-force operations in the Pacific.

The deck-edge elevator speeds battle action aboard the carriers because it enables plane-handling crews to keep the central flight deck cleared of incoming planes as fast as they land. As



Westinghouse multistage, axial-flow gas turbine designed for airplane-propeller drive.

the 50-ton platform is to one side of the flight strip, landed planes can be moved aside, out of the flight area, with a minimum of handling. During take-offs it permits faster delivery of planes from the hangar deck and prevents planes awaiting take-off from "bunching up" around the elevator openings, as they did when only the bow and stern deck elevators were available for delivery from below. In addition to speeding battle action, the new elevator also makes the carrier less vulnerable by eliminating a hole about the size of a bomb crater from the middle of the deck-top airstrip. Formerly a 40-ft. square center-deck elevator, if damaged by enemy missile, could immobilize a carrier's entire plane fleet.

The platform, 34 ft. wide and 60 ft. long, is hung outboard over the sea at the edge of the flight deck, opposite the carrier's superstructure. Built of welded pipe made of a special tough steel alloy, it meets Navy requirements that it lift an 18,000-lb. load, the equivalent of one heavy or two light shipboard fighters, from hangar deck to flight deck and return for another load at a rapid rate. In use, it also carries a towing tractor and the handling crew. Because the carriers were designed to pass through the locks of the Panama Canal, the 34-ft. wide elevator platform is mounted so it will fold up and not strike the side of the canal locks.

Planes are hauled to and from the elevator platform from the carrier's hangar through a 60- by 20-ft. hole—closed by sliding doors—cut in the side of the vessel at the level of the hangar deck three decks below the flight deck. Running the height of the three decks on the forward and aft edges of this hole are heavy guide rails, anchored into the structure of the ship. Heavy steel rollers on the inboard edge of the elevator platform run up and down in channels in these guide rails. The platform is lifted and lowered by means of $8^1/_8$-in. steel cables, which pass over a series of direction-changing and leverage-multiplying sheaves and are attached to either end of a hydraulic piston and cylinder assembly which supplies power for the system. This "engine" eliminates necessity for two steel columns, or "rams," through the hangar deck on which the earlier center-deck elevators were mounted. The piston of the engine is activated by oil pressure led into the cylinder from a pair of compression tanks, where two 150-hp. electric motors, operating variable-stroke pumps, maintain oil pressure at a constant 850 lbs. per sq.in. Westinghouse Electric Corporation, Elevator and Air-Conditioning Division.

"Aisle of Light" for Idlewild

An "aisle of light," two towering walls of light flanking a broad concrete runway 8,400-ft. long, will help to make "all-weather" flying possible at Idlewild Municipal Airport, New York. The new lighting technique, combined with radar-radio instrument-landing equipment and other war-developed blind flying aids, is being instituted to assist the air lines in maintaining precise arrival and departure schedules despite the worst flying weather the Atlantic seaboard can produce.

Composed of two curtains of light shooting skyward, the "aisle of light" is said to be a marked contrast to the usual runway marker lights that look to incoming pilots like illuminated dots on the runway edge. They are so planned that the approaching pilot will see the runway as a dark area between twin "sheets" of controlled light that shoot upward without glaring in his eyes. The runway surface will be illuminated by smaller lamps from the same fixture to the low-surface brightness preferred by airmen.

Each unit of the new system of landing lights will include a 300-watt "sealed beam" floodlight with a prismatic lens that will "fan out" light parallel to the runway. The units will be spaced 200-ft. apart according to present plans, with provisions for 100-ft. spacings in the future. The fanning effect will create an interlocked "wall" of light a short distance above the runway. The floodlight unit will have a contact light mounted on the same base so that the "aisle of light" can be used for periods of bad weather, but in good visibility normal runway lighting will be available.

Green "threshold" lights, stretched across the ends of the runway to inform the pilot that runway surface is imminent, will be placed at 15 ft. from the end of the runway, and like the runway lights proper, will be raised 15 in. above the surface. The landing aid will use 30,000 watts of light, more than four times the light intensity used for the standard runways in service today. The "aisle of light" runway will have four 3,000-watt floodlights, a green arrow and red cross neon-light traffic approach signal, and a newly developed smoke generator at each of its ends. Projectors will be placed at each side throughout the length of the runway. Westinghouse Electric Corporation.

Air-Turbine Powered Radio Fuses

Contributions to development and production of radio-operated proximity fuses—for detonating aerial bombs, rockets, and antiaircraft, mortar, and howitzer projectiles at exactly the distance from targets to ensure greatest damage—were revealed recently as Army and Navy officials removed the regulations that have shrouded these weapons in secrecy. One of these developments was a safer-handling and improved radio-type fuse that generated its own electrical power in flight by employing a small wind turbine designed, developed, and produced by Westinghouse. The unit, known as the T-82, also included a basic radio circuit. The wind-turbine fuse was used extensively by the Army for aerial bombs, mortars, and rockets, and replaced both the photoelectric fuse and the battery-operated radio-type unit which were designed for rocket detonation. The T-82 unit transmitted and received a reflected radio signal. The small rotor of its wind turbine, no larger than the face of a pocket watch, turned at the rate of 40,000 r.p.m. Westinghouse Electric Corporation.

Erratum

An item appearing on page 137 of the November, 1945, issue of the AERONAUTICAL ENGINEERING REVIEW referred to tungsten-carbide gage blocks manufactured by Fonda Gage Company, Stamford, Conn., giving a size range of 0.001 in. to 4.00 in. The manufacturer has stated that the information upon which that item was based contained an error with respect to the smaller of those dimensions, which should read 0.1001 in. (*Ed.*)

Changes of Address

To facilitate the prompt receipt of copies of the *Journal* and *Review*, members and subscribers are requested to give the editorial offices 30 days' notice of any change of address.

Notices should be sent directly to the Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N.Y.

An Open Letter on Policy

Regarding KOLLSMAN Products and the new

Scout

Instruments

Kollsman intends to continue the development and manufacture of instruments second to none in precision and reliability for the Military Forces and Airlines of the United States. This is the field where the ultimate is required, expected and demanded. We have the vision, the facilities and the staff to provide it.

This same Kollsman standard of quality guides us also in the manufacture of instruments for private aircraft. If personal airplanes are to be built and used in large numbers, and if the industry is to grow as it should — and as it can — certain quality standards must be maintained. The airplane is not the vehicle with which to experiment in order to determine how cheap an instrument one can get by with. An inaccurate or unreliable instrument is worse than none at all. Quality will never be subordinated to price in any Kollsman instrument.

Our new Scout line of instruments for personal airplanes — at prices well within the reach of the private flyer — was made possible by re-designing the standard airline and military instruments to the performance requirements of the private plane. Their ruggedness, accuracy and trustworthiness can be important aids to the safety and utility of private aircraft.

This, then, is our policy for the future in the manufacture of aircraft instruments. We believe it will contribute much to the healthy growth of the industry.

R E Carbonara

Vice President, Square D Company
General Manager, Kollsman Instrument Division

KOLLSMAN INSTRUMENT DIVISION OF SQUARE D COMPANY, 80-08 45th AVENUE, ELMHURST, N. Y.